SECTION III

LAUNCHING UNITS OF JETS (1938-1945)

Chapter 1

The Mystery of Engineer Kostikov

In February 1938, at NII-3, under the leadership of A.G. Kostikov, work began on the creation of means for volley fire or firing bursts of rockets with chemical warheads. At this time, NII-3, by order of GAU, developed individual launchers for firing rockets with chemical warheads. Initially, the technical assignment of the GAU provided for the creation of light launchers that could be transported to a firing position by car, removed and installed manually in the line of fire with a preparation time for firing no more than one hour.
In June 1938, the designer E.S.Petrov developed drawings of such a machine according to the traditional, previously tested scheme. However, this project was rejected by the customer and the technical council of the institute.
On July 5, 1938, by order of the director B.M. Slonimer, a closed competition was announced at the institute for the creation of the best design of the launching machine, in the conditions of which the previous technical task of the GAU remained. 18 specialists of the institute took part in the competition.
On August 27, 1938, engineer I.I.Gvay provided a project for a mobile multiple-charge salvo unit for firing chemical rocket projectiles. The project substantiated not only the design of the installation, but also the tactics of using a fundamentally new combat weapon: the charged installation secretly takes a combat position, the preparation time for firing is 3-4 minutes (instead of one hour on assignment), the duration of a volley of 24 shells is several seconds ; after the last shot, the installation immediately leaves the position and thus becomes invulnerable to the enemy's retaliatory fire strike.
In official letters from the director of NII-3 V.M. Slonimer, sent in 1938-1939 to the People's Commissar for Ammunition of the USSR I.P. Sergeev, the chief engineer of the institute A.G. Kostikov was named the initiator of the idea of creating a mechanized installation for a chemical attack, at the same time opening up the possibility of using rocket shells in the ground forces of the Red Army. ...
Here the author is forced to stop and touch upon a topic that he extremely disliked - the dispute over the priorities in inventions. For 40 years a battle has been going on in the pages of the national press - they are looking for the father of "Katyusha". Well, just like in numerous Mexican TV shows they cannot determine the father of the child. The main contender for the role of father is Andrei Grigorievich Kostikov (1899-1951). In 1933, Kostikov entered the Russian Research Institute and worked there on the creation of liquid jet engines using oxygen-kerosene fuel. In 1936 he was appointed head of the liquid propellant rocket engine department. In August 1937, he was removed from office, and in November the director of the Kleimenov Institute was arrested on charges of counter-revolutionary activities. At the same time, chief engineer Langemak was arrested. In January 1938, they were convicted and shot.
BS Slonimer, who had never been involved in jet technology before, was appointed the new director of NII-3, and A.G. Kostikov was the chief engineer. In March and June 1938, two more leading experts, Glushko and Korolev, were arrested under the same Article 58. Even then there was a version that these specialists were arrested on the basis of Kostikov's denunciations. Kostikov really had conflicts with all the arrested specialists. The NKVD from NII-3 sent an "Examination Act", which negatively characterized the work of Korolev and Glushko. Under the act, among others, was Kostikov's signature. However, it seems that no one has yet seen the denunciations of Kostikov. So the degree of Kostikov's guilt cannot be established to this day. To do this, you need to do a good job in the archives of the NKVD, and there our democratic leaders are great lovers of publicity,
For those readers who are not familiar with the work of Soviet research institutes, the author can only explain that it is simply impossible to understand who did what and who did what, according to the official documentation. For example, in the mid-1980s, the author developed an automated process control system "Urea", and in a thick volume of documentation he was listed as the performer, and the chief designer was an elderly leader, the boss of my boss, who saw the project only when he signed the documentation. So it was, so it seems, and will continue to be in Russia.
In the author's opinion, it is much more interesting to write about the technical characteristics of weapons, their tests, combat use, etc., rather than about squabbles in Soviet research institutes. And “fatherhood” should be approached purely formally: whoever was indicated in the project as the chief designer is the master, and the squabblers should be sent to hell. I will note that I, a sinner, even with such a cautious position, are often poured with slops. So, for example, a certain LB Kizner * wrote: “Note that Shirokorad is also mistaken when he asserts that Petropavlovsky was engaged in a dynamo-jet cannon. In fact, Petropavlovsky never dealt with them. " And across the page: "Petropavlovsky incorrectly called his

rocket cannon gas-dynamic, just as Ryabushinsky made the mistake of calling his dynamo-reactive cannon a jet gun." Where is Shirokorad to classify the gun of Petropavlovsky,

* Kizner L. "Facts alone." M., 1995.S. 79-80. 266

As for the one who was the creator of the M-13 complex, then dozens and even hundreds of names must be named, from simple engineers to senior managers who took responsibility for the mass production of the complex. I hope that this whole book will prove this thesis.

Chapter 2

Launchers of 132mm M-13 missiles

The first two self-propelled launchers for 132mm missiles were manufactured at NII-3 in early December 1938. The launcher was on the chassis of a ZIS-5 car and had 24 single-bar groove-type guides mounted on a special frame across the vehicle axis.

From December 1938 to February 1939, field tests of RSX-132 chemical projectiles were carried out at the Central Military Chemical Range near Moscow. The chairman of the test commission V. D. Grendal signed an act in which the system was highly appreciated: “... the idea of firing a large number of missiles is, of course, correct and relevant ... attacks ".

The Commission also noted a number of significant shortcomings. The design of the launcher made it possible to launch rockets only perpendicular to the longitudinal axis of the vehicle, and the jets of hot gases damaged the elements of the installation and the vehicle. Safety was not ensured when controlling fire from the vehicle cabin. The launcher swayed strongly, which worsened the accuracy of the firing of rockets. The ZIS-5 vehicle had limited maneuverability. The shells gave a very poor accuracy, which, however, was quite tolerable for chemical munitions.

Taking into account the commission's remarks, the NII-3 team began work on improving missile weapons for the ground forces. In the RS-132 projectiles, the disc diaphragm was replaced with a grate, which significantly reduced the release of unburned powder charge particles from the rocket chamber and the dispersion of projectiles at range. The plain igniter was replaced with a moisture resistant one in a hard case, since most of the failures and protracted ignition of the rocket charge occurred due to dampness or destruction of the plain igniter.

Due to frequent failures in the ignition of the rocket charge with one central squib, duplicate ignition was introduced into the RS-132 using two so-called pyrospots. They were located on the front leading belt of the projectile on both sides of the guide pin. This design change made it possible to significantly reduce the loading time of the combat vehicle, since when the projectile was inserted onto the guide electrical contacts of the glow plugs, they came into contact with the current-conducting contacts of the guide bar.

The design of the stabilizers was changed. Cast duralumin stabilizers were replaced by stamped steel, welded from two halves. At the same time, the weight increased slightly, but the rigidity due to the longitudinal corrugations increased several times.

In 1939, NII-3 developed two launchers for 132-mm missiles.

Installation MU-1 (mechanized installation, 1st sample) had elongated guides, but they were still located perpendicular to the axis of the machine. The MU-1 installation was mounted on the chassis of a ZIS-6 all-terrain vehicle. The number of guides remained the same - 24, but they were staggered on the frame. The elevation angle of the guides varied from + 15 ° to + 45 °. The frame of the guide package had a horizontal guidance angle of ± 5 °. The car had two folding jacks that hung the rear of the launcher in a firing position. For precise guidance of the launcher in the horizontal plane, an artillery sight and a panorama from a 122-mm howitzer were installed on it.

Tests of the MU-1 revealed its poor stability when firing (swinging), which led to a large dispersion of shells. Therefore, a new model of the MU-2 launcher was created at NII-3.

The MU-2 launcher had 16 flute-type guides located along the axis of the vehicle. Each two rails were connected (mated), forming a single structure, called a pair. There were eight Sparks. In the MU-2 installation, as in the MU-1, the machine was jacked up. But, due to the location of the rails along the chassis of the car, the forces that swing the launcher were applied along the axis of the car on two jacks located near the center of gravity. Therefore, swaying is minimal. In the MU-2 installation, loading was carried out from the breech, that is, from the rear end of the guides. It was more convenient and the loading time was significantly reduced. All 16 shells could be fired in 7-10 seconds.

In August 1939, the MU-2 launcher was manufactured and factory tested. On September 19, 1939, BM-13 * was accepted from NII-3 by a representative of GAU for field tests. (Fig. 93)

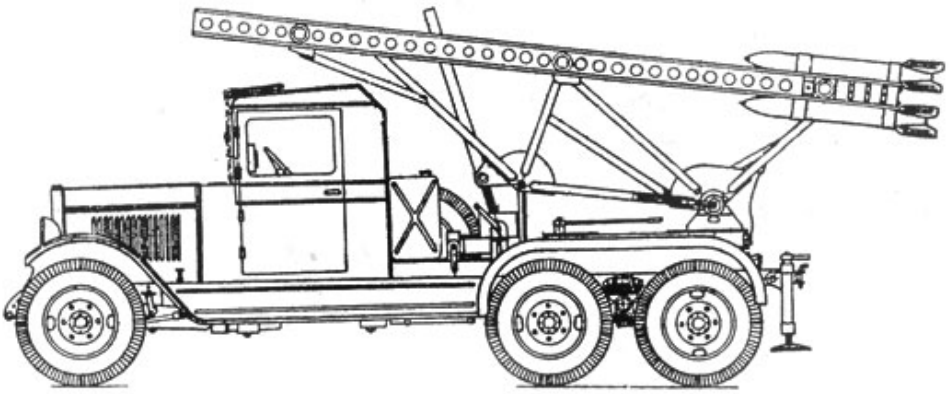
* The name of the BM-13 launcher is given by the author for the convenience of the reader. In fact, the launcher in the documents of 1941 had several names: "gun mount for launching 132-mm PC", "mechanized installation for RS-132" (minutes of the technical meeting on design changes in the

drawings dated 08.04.1941 . at the plant named after. Komintern), "auto installation for launching RS-132". Since the beginning of the war, with the intensification of work to further improve the installation, it began to be called even more diverse. In archival documents in the period from July 4 to December 1, 1941, the following names are found: "installation for launching the RS-132", "automatic installation for the RS-132 mm", "product M-13", "mechanized installation M-13" , "M-13 on ZIS-6", "combat vehicle M-13". Most often at the beginning of the war, the name "machine M-13" and the name "auto installation for launching RS-132". However, the author, in order not to create confusion, calls the installation for M-13 missiles on the chassis of a ZIS-6 vehicle BM-13.

From September 28 to November 9, 1939, field tests of 132-mm and 203-mm high-explosive fragmentation rockets, MU-1, BM-13 (MU-2) launchers and a universal launcher were carried out at NIAP. Only the BM-13 launcher and the M-13 rocket passed the tests.

At the end of December 1939, the M-13 rocket and the BM-13 launcher were approved by GAU, and NII-3 gave an order for the manufacture of five such installations for military trials. In addition, the Navy's Artillery Directorate ordered one BM-13 launcher for use in the coastal defense system.

Fig. 93. Experienced combat vehicle BM-13-16 on the ZIS-6 chassis

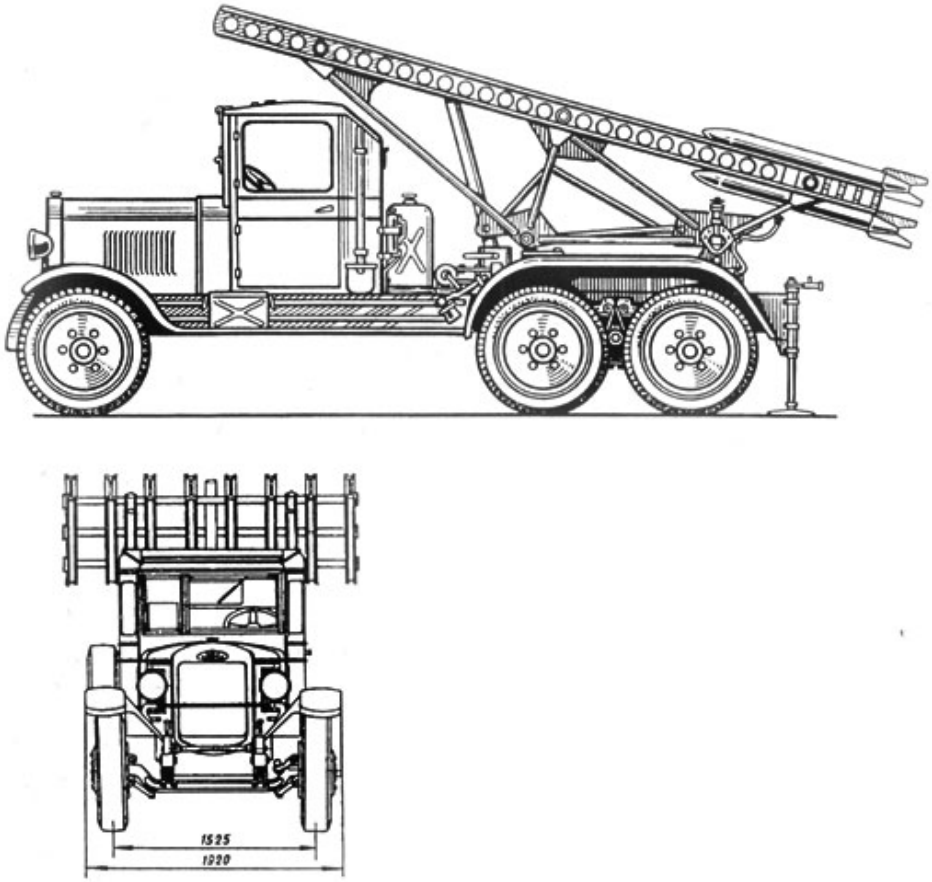


During the summer and autumn of 1940, NII-3 manufactured six BM-13 launchers. Five of them were sent to the range for test firing. The sixth launcher, together with a batch of signal and lighting 140-mm rockets, developed under the leadership of V.A.Artemiev and L.E.Shvarts, were sent to Sevastopol for testing. Its tests were completed in April 1941. The Commission recommended to adopt lighting shells for use with coastal batteries.

After the war, the former People's Commissar for Ammunition P. N. Goremykin recalled that the military, referring to the insufficient accuracy of the rockets, ordered them in small quantities - mainly prototypes and batches. During 1940, the factories produced only 1000, and by May 1, 1941 - 10 788 M-13 shells. Orders for launchers were also insignificant.

In January 1941, the People's Commissariat of General Machine Building received an order from GAU for the manufacture of only 40 BM-13 launchers during 1941, 20 of them in the second quarter and 20 in the third quarter. (Fig. 94, 95)

Fig. 94. BM-13-16 serial launcher on the ZIS-6 chassis



Rocket Launchers (1938-1945)

From June 15 to June 17, 1941, at the Sofrinsky training ground near Moscow, the leaders of the party and government were shown new types of weapons, including experimental prototypes of a launcher for 132-mm rockets, manufactured by NII-3.

On June 21, 1941, the day before the start of the war, five BM-13 combat vehicles were personally inspected by I.V. Stalin, Kostikov gave explanations on the system. On the same day, a government decree was adopted on the deployment of serial production of M-13 rockets and a BM-13 launcher and on the beginning of the formation of missile military units.

The place of mass production of BM-13 was the plant named after V. Comintern in Voronezh. Back on February 6, 1941, drawings of launchers were sent from NII-3 to Voronezh. Upon receipt of the NII-3 drawings for the installation by the plant, the need for their serious structural processing became clear. This was caused, firstly, by the need to make changes to them in accordance with the remarks regarding structural simplifications and improving the tactical and technical characteristics, and, secondly, by the requirements of the technology of industrial serial production of launchers. During March-April, the design of a number of the main components of the launcher underwent a radical revision at the plant and received a new design solution that meets the features of pilot production. The box-shaped design of the pair of the guide has undergone radical design changes,

General arrangement drawings, developed in the design bureau of the plant. Comintern, were ready by June 10, 1941. However, during the development of the drawings in the design bureau of the plant, the installation was neither constructively nor technologically finished with testing for serial production and combat operation. Individual units of the installation, for example, guides, were not tested and were not strong enough, and the rotary device was made in two versions. The choice of the best of them took place during the tests of the first two experimental installations at the range on July 5, 1941, that is, after the start of the war.

The first two launchers BM-13, manufactured at the plant. Comintern, were sent to Moscow on the morning of July 2, 1941. On July 5, the units were tested at a test site near Moscow, and then sent to the Moscow plant "Compressor" (No. 733) to eliminate the shortcomings.

From July 10, 1941, the plant named after. The Comintern began producing launchers and until July 26 was the only enterprise in the country for their production. On July 26, the first unit was produced by the Compressor plant. On August 12, 1941, as is clear from the report of the military representative of the Compressor plant, 53 units were already delivered to the Red Army, and the plant named after The Comintern of this number was made 41 units.

The design of the BM-13 serial installations, manufactured in July-August 1941, was far from perfect. It was reported from the front that the strips on the guides were often torn off due to their poor fastening, at the maximum elevation angles and with some horizontal rotation of the swing mechanism, the stabilizers of some shells touched the jacks. On August 16, 1941, there was a case of a breakdown of the stabilizer and for this reason the fall of shells in the area of the observation post. Naturally, the identified design flaws were immediately eliminated.

By November 1, 1941, factories named after. Kominterna, Kompressor and Krasnaya Presnya, 456 BM-13 launchers on the ZIS-6 chassis and 15 launchers for M-13 rockets on the ZIS-5 chassis were manufactured. Note that the attempt to mount launchers for the M-13 on the chassis of the ZIS-5 car was unsuccessful and their production was discontinued.

At the end of September 1941, the SKV of the Compressor plant began to create a launcher for the M-13 on the chassis of the STZ-5 tractor (produced by NATI), which has a large carrying capacity, good maneuverability and a large motor resource. The weight of the tractor was 6 tons, the power of the gasoline engine was 52 hp. from. The creation of the M-13 launcher on the chassis of the STZ-5 tractor was caused by two reasons. Firstly, the passability of the ZIS-6 car on our roads in the fall left much to be desired, and secondly, very few ZIS-6 cars were produced. (Fig. 96)

The design of the artillery unit, due to the specific features of the tractor chassis frame (large dynamic, vibration and shock loads on the march due to the shorter base at the frame), has undergone significant changes. A special unit was introduced into the design of the launcher - a stretcher. All the main units of the artillery part of the installation were mounted and fastened on the stretcher, and then it (together with the installation units fixed on it) was fastened through a shock-absorbing gasket to the tractor chassis frame with fastening clamps. This managed to remove large dynamic loads from the structure of the artillery unit of the launcher on the march. Mounting the artillery unit on the chassis through shock-absorbing pads began to be used in all installations. Another innovation was the redesign of the truss of the rocking part of the launcher, as a result, a zero initial elevation angle of the package of guides was obtained against + 15 ° for the M-13 installation on the ZIS-6 chassis. This allowed direct fire to be fired.

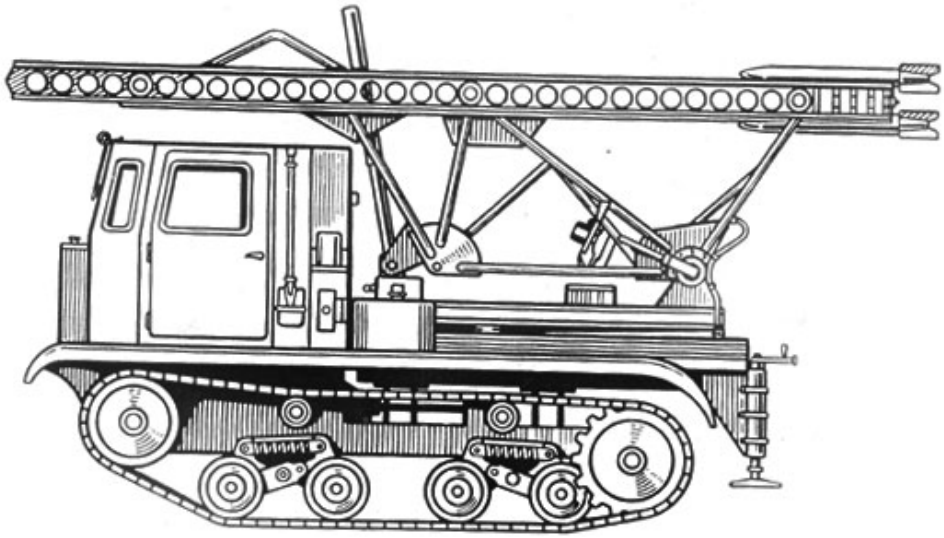


Fig. 96. Launcher RS-132 on the tracked tractor STZ-5-NATI

But the BM-13 launcher on the chassis of the STZ-5 tractor also had disadvantages, the main of which was the low speed (10-14 km / h) and the small power reserve (about 200 km) of the STZ-5 tractor, which sharply reduced the maneuverability of the parts rocket artillery.

Prototypes of launchers for M-13 projectiles on the STZ-5 chassis passed field tests in October 1941 and were put into service. Their serial production was started at the plant. Comintern in Voronezh. However, due to the indicated disadvantages of the installation, its production was limited to a small batch.

At the Compressor plant, they tried to make an installation for launching M-13 projectiles on a T-40 light tank or a T-60 tank close to it in design. The tests of the M-13 launcher on the T-40 tank carried out in September 1941 gave satisfactory results. Good ballistic qualities of the installation were noted, but it was not accepted into service. The reason for this was the imbalance in the center of gravity of the tank due to a change in the weight of a charged and unloaded launcher, and therefore the undercarriage of the tank experienced significant overloads on the march.

In July 1942, at SKB-2 of the plant. Kirov in besieged Leningrad, the design of a launcher for 132-mm M-13 missiles began, which received the KARS-1 index. CARS is an abbreviation of the short artillery missile system. The heavy tank KV-1 was taken as the chassis. The installation was an armored container with an opening front cover, inside which two rockets were installed on the guides. In total, four such containers were mounted on the tank (on the mud wings). The tank

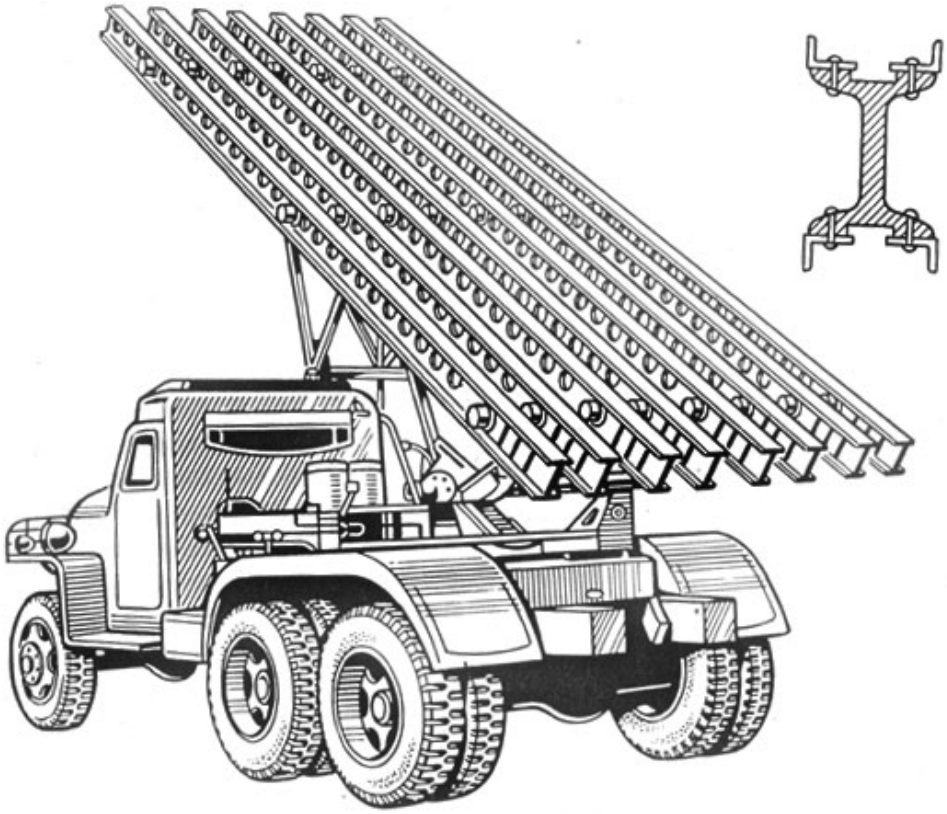
could volley or sequentially launch eight shells, and firing was possible only in the direction of movement of the tank. Guidance in both planes was carried out by the tank hull. Tests of a tank installation with different guide lengths (2000, 1200, 1250 and 2400 mm), carried out on August 7-8, August 17-30 and October 1942 showed satisfactory results. It was found that "the obtained data on accuracy and range hardly differ from the tabular data" for guides with a length of 5000 mm. Based on the tests, it was concluded that the CARS could become an effective additional weapon for the KV tank. The KARS launcher was approved by the Main Directorate of Missile Armament of the Guards Mortar Units of the Red Army, which recommended that it be adopted for arming KV tanks. At the same time, disadvantages of the installation were also noted, such as the lack of independent (from the tank hull) horizontal and vertical guidance, which significantly reduced the maneuverability of fire, as well as an increase in the lateral dispersion of rockets by 1.5 times compared with the standard M-13 launcher. ... However, due to the termination of production of KB tanks, the installation did not go into series.

Success in the creation of the KARS-1 tank launcher contributed to the fact that in late 1942 - early 1943, the Chelyabinsk Compressor plant developed a design for a similar installation on a 1.5-ton GAZ-AA machine. The installation received the index CARS-2. The field tests carried out showed that the length of the guides of 1250 mm did not provide the required accuracy of firing rockets. The possible angle of horizontal firing turned out to be insufficient, and its increase required significant modifications (changing the shape of the car's cabin, increasing the weight of the installation, which would make it impossible to mount it on the chassis of a 1.5-ton car). In this regard, the production of KARS-2 was deemed inappropriate.

As already mentioned, the number of ZIS-6 vehicles was limited, and a few months after the start of the war, their production was completely discontinued. However, in the winter of 1941-1942, American, Canadian and British cars began to arrive in the USSR. In this regard, several types of launchers were created on the chassis of the cars "Studebaker", "International", "Austin", "Ford" (Canadian), "Jamsa", "Chevrolet", "Dodge", "Bedford", etc. Some vehicles were found to be unsuitable for use as combat vehicles. So, for example, in the conclusion of the SCV commission at the Compressor plant, signed by V.P. Barmin, A.N. Vasiliev, N.F. Konoiko, on the inspection of the M-13 units that arrived from the front in July 1942, mounted on the chassis Dodge, it was recorded, that Dodge vehicles should not be used in the future for the installation of the M-13 unit due to damage to the side members during operation. A similar conclusion was made for the Chevrolet car and for some others. This subsequently led to a decrease in the number of types of vehicles used, foreign brands for mounting launchers on them. The most widely used cars are Studebaker, International and Ford-Marmon. (Fig. 97)

During the war years, launchers for M-13 and M-8 missiles were produced by the Compressor factories (Moscow); Comintern (Voronezh), "Chelyabkompressor" (Chelyabinsk), "Uralelektroapparat" (Sverdlovsk), them. Kuibyshev (Kirov), Mechanical (Penza), Milling machines (Gorky), them. Karl Marx (Leningrad), them. Shevchenko (Kharkov), "Krasnaya Presnya" (Moscow) and others.

Fig. 97. BM-13 combat mount on the Studebaker chassis



Chapter 3

Launchers for 82mm M-8 missiles

The design of launchers for 82-mm rockets was not carried out at NII-3. For the first time, the design of such installations was started in July 1941 at the SKB of the Compressor plant. A preliminary study of the assignment, carried out in July 1941 at the SKB, showed that on the basis of the chassis of the ZIS-5 and ZIS-6 vehicles, it is possible to create a 38-round self-propelled launcher with flute-type guides, which were used in aviation for aircraft rocket launchers. At the same time, a reduction in the development time of the installation and its manufacture was achieved, since these guides could be obtained from the serial manufacturer, as well as a number of units and parts from the M-13 installation could be used.
At the beginning of July, the Compressor plant manufactured two prototypes of launchers with 38 guides. One of the samples was installed on the ZIS-5 chassis, the second on the ZIS-6 chassis.
Tests of these samples of launchers for 82-mm rockets took place at the artillery range near Moscow on July 30, 1941. The installations were loaded with a full set of shells and tested for the strength of the installations, density and area of damage when firing 38 shells in salvo. The tests gave positive results. Installation on a ZIS-6 car was recommended for adoption as more maneuverable.
At a technical meeting in the SKB of the Compressor plant, which was held on August 9, 1941, it was decided to reduce the number of guides to 36 to increase the reliability of the installation, since their layout did not exclude the possibility of the rocket tail (at low firing angles) touching the horizontal guidance screw casing ... The installation received the BM-8-36 index. (Fig. 98)
The BM-8-36 launcher was adopted by the Red Army on August 6, 1941 and transferred for serial production to the Compressor and Krasnaya Presnya factories. By the beginning of September 1941, the factories produced 72 installations of this type, and by November - 270 installations.

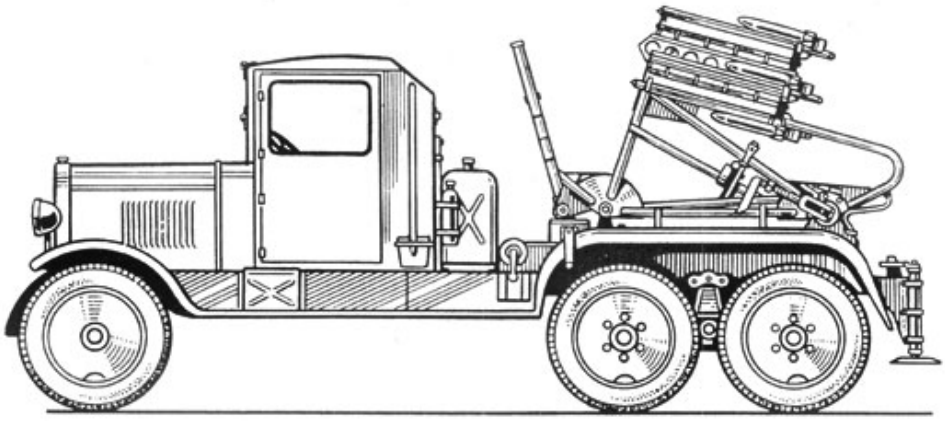


Fig. 98. Fighting vehicle BM-8-36 on the ZIS-6 chassis

At the beginning of October 1941, on the instructions of the Main Directorate of Armaments of the Guards Mortar Units, the design group of the SKB of the Compressor plant, headed by V.A. tanks T-40 and T-60. The installation was intended for firing M-8 rockets of all modifications. She was distinguished by high maneuverability, had a shelter for the combat crew in the tank hull and allowed direct fire. (Fig. 99)
In mid-September 1941, two 24-charge launchers on T-40 tanks were already manufactured and in the 20th of September they were presented for testing. The test program included: identification of the advantages and disadvantages of the M-8 unit mounted on a tank compared to the M-8 unit mounted on a ZIS-6 vehicle; determination of the maximum range and dispersion of 82-mm rockets when firing from tested installations; identification of the possibility and feasibility of shooting at guide angles of 0 ° and less.

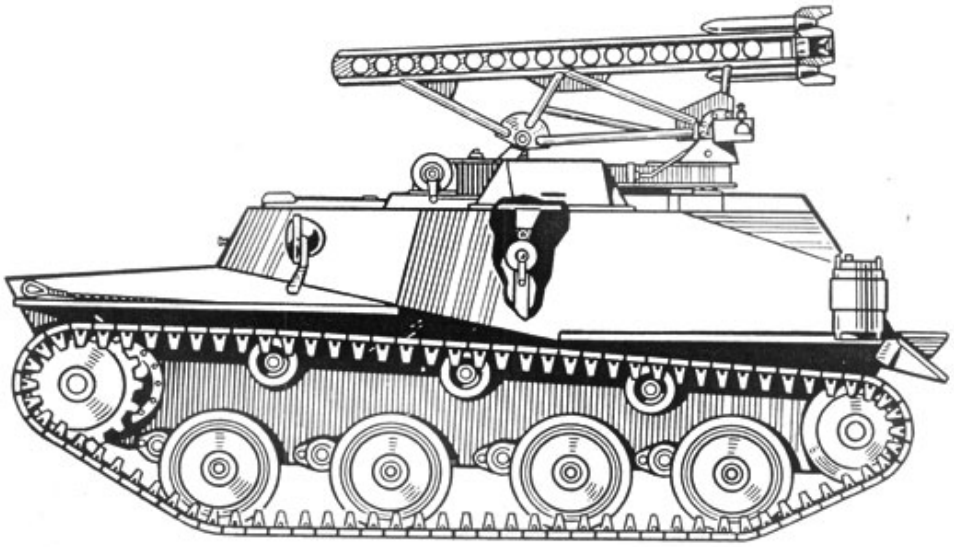


Fig. 99. Fighting vehicle BM-8-24 on the chassis of the T-60 (T-40) tank

According to the test results, it was found that a light tank T-40 or T-60 can be equipped with installations for launching 82-mm rockets. Mounting the launcher on a light tank gave some advantages over the launcher mounted on a ZIS-6 vehicle. This is an increase in the sector of shelling along the horizon and a large cross-country ability, which provided great opportunities in choosing a firing position. However, the dispersion of rockets when firing at medium elevation angles (about 25 °) turned out to be more than acceptable, and because of this, the launcher on the T-40 light tank was not accepted for service.
In July 1941, the designers Brashchenko, Kovalev and Zenkov * proposed a design for a launcher for 82-mm rockets on the Maxim machine gun of the Sokolov system. Six guides of the "flute" type were installed on the machine-gun machine.

* The author was unable to establish their initials.

In late July - early August, the installation passed field tests. As stated in the test report of August 3, 1941, "the installation provided a completely normal flight of shells," but due to a number of serious defects it was removed from further tests.

Among the shortcomings were the fragility of the fastening of the guides, one of the guides had a large backlash, the parallelism of the guides in the horizontal and vertical planes was not observed, which led to a large dispersion of shells when firing. According to the commission, the installation required major structural improvements: in addition to eliminating the listed shortcomings, it was recommended to install a sighting device, simplify the design of pyro pistols *, etc. After eliminating all the shortcomings, according to the test site, it is possible to fire from the installation at enemy manpower.

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* Pyro pistol (fire link) - an ignition device for starting (communication of fire to a fuel projectile).

In July-August 1941, a motorcycle installation for 82-mm rockets was designed at NII-3. In a motorcycle sidecar, on a special platform, 12 aircraft guides of the "flute" type were mounted, equipped with pyro pistols.

Factory tests of the motorcycle launcher were carried out on September 8, 1941. 11 missile launches were made, with the operator on a motorcycle. It is noted that the fundamental issues of firing rockets from a motorcycle have been resolved positively. Durability and shielding (from the action of the gas jet) were found to be satisfactory. Among the shortcomings, it was noted: knocking down horizontal guidance after each shot; operations with the vertical guidance mechanism are inconvenient; recharging takes a long time (4 minutes). The commission recommended to strengthen the platform, to protect it from dirt entering the guides, sheathed the bottom with a metal sheet. Despite the shortcomings, the installation was presented for field tests, which were carried out on September 17, 1941, and showed that the installation did not meet the requirements. presented to a jet weapon. Of the 12 launches made, 6 shells fell at a distance of 50 m from the installation. During the launches, there was a strong knock of the entire motorcycle in the lateral direction. Installation work was discontinued.

Since September 1941, GAU received several proposals for the installation of launchers of 82-mm rockets on a snowmobile. But these projects were not implemented for two reasons. Firstly, the installations had seasonal chassis, that is, they could only move along a snow or ice crust, which excluded their effect during a thaw, as well as in those areas of the front where there was no snow cover. Secondly, the existing snowmobiles, due to their low carrying capacity, allowed the installation of only four guides, which reduced the effectiveness of a salvo rocket weapon. In December 1941, a proposal was put forward to tow self-propelled sleds with installations mounted on them by snowmobiles. Several samples of launchers for M-8 and M-13 missiles on sledges were made, but they did not go into series. (Fig.

At the beginning of November 1941, an attempt was made to create an installation for launching 82-mm rockets at a distance of the fighter's line of sight, that is, for direct escort of infantry. As can be seen from the archival materials, the installation did not have a standard basis, since during the tests it was placed on a wooden platform. Five shots were fired. Tests showed poor stability when firing, the installation was very confused, it took a lot of time to give it its initial position (after the shot). At the last shot, the projectile made a "dive" and fell 20 m from the installation. Due to the large number of design flaws, the installation was not recommended for adoption.

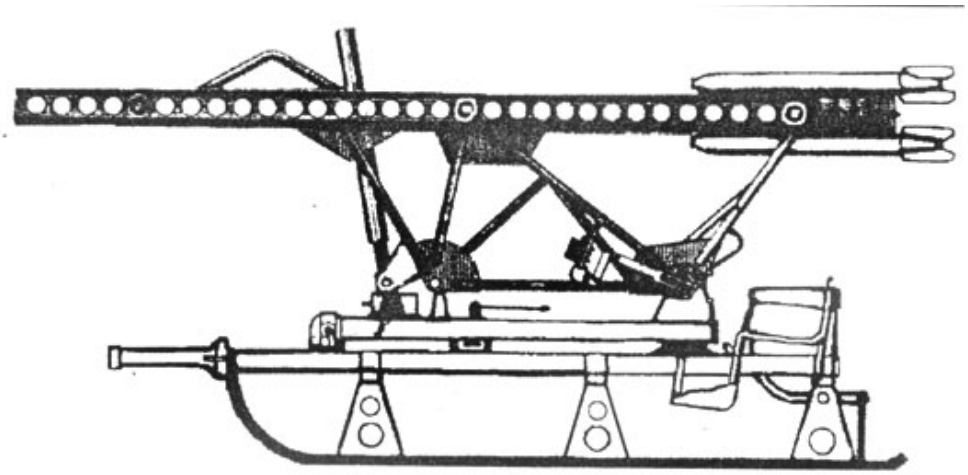


Fig. 100. Launcher M-13 on a sleigh

For the first time, a launcher for direct support of infantry was created in the SKV of the Compressor plant. At the beginning of 1944, a self-propelled armored vehicle called "Sturmovik" was developed there on the chassis of a ZIS-6 vehicle. In "Sturmovik" for the first time, aiming at a target from the cockpit was implemented using a mechanical drive. The installation was designed to launch 132-mm rockets. Field tests of the "Shturmovik" took place in May 1944, but due to the low accuracy of fire, the installation was not accepted for service.

In November 1941, work began on the design of launchers on a single-horse carriage. In accordance with the tactical and technical assignment, it was required to develop a 16-charge installation for 82-mm rockets. NII-3 and TsKB-19 of the

People's Commissariat of the shipbuilding industry took part in the development. Prototype units were made and comparative tests were carried out in August 1942. The 12-charge M-8-M, developed by TsKB-19, was put into service. The industry received an order for 355 such units, but after the manufacture of 163 units, their production was discontinued. The horse-drawn launcher, developed by NII-3, was not accepted for service, and further work on it was stopped.

In 1942, the Gorky Milling Machine Plant developed a 60-charge launcher on the GAZ-AA chassis for 82-mm rockets, but due to chassis overload, it was not widely used. Only 50 such units were manufactured.

In 1942, two projects of installations for launching 82-mm rockets from a human shoulder were developed. The installations were intended to combat tanks. One of the projects was developed by TsKB TsAGI. It provided for the reduction of scattering to impart rotation to the rocket due to the outflow of gases through the tangential nozzles. In May 1942, the development of this unit was completed by a group of Narkomneft specialists under the leadership of A.P. Ostrovsky. The installation was named "System". Tests showed the Sistema's unsatisfactory accuracy of fire, and the installation was not accepted for service.

In March 1942, a project was developed at the Gorky Plant of Milling Machines and a prototype of an experimental launcher was manufactured on the chassis of a Studebaker car. The tests were carried out in early April. When the rockets were launched, the roof of the cockpit tore off, glass flew out, and the installation was removed from testing.

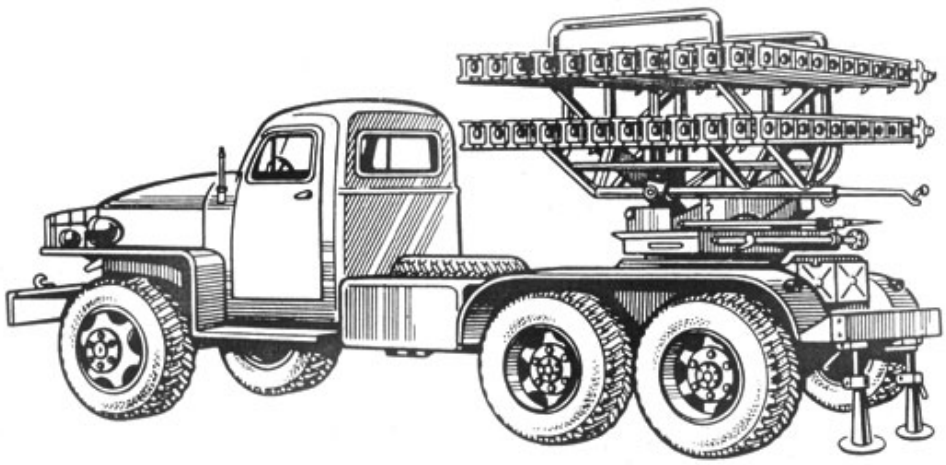


Fig. 101. Fighting vehicle BM-8-48 on the chassis of the vehicle "Studebaker"

In the fall of 1941, an 82-mm BM-8-36 launcher was tested on the ZIS-5 chassis. The installation showed satisfactory ballistic qualities, but was not put into service due to poor maneuverability on dirt roads. The BM-8-36 launcher was also designed on the ZIS-6 chassis, but with the chassis, as already mentioned, there was a lot of "tension", and this launcher was not accepted into service.

In the summer of 1942, several launchers for 82-mm M-8 missiles on the chassis of imported cars entered service. So, the SKB of the Compressor plant mounted the BM-8-36 launcher on a Chevrolet car.

In April-June 1942, a 48-charge launcher BM-8-48 was designed by the design team of V.M. Vasiliev at the SKB of the Compressor plant. The peculiarity of its design consisted in the use of two packages of guides of the "beam" type from the BM-8-24 launcher on the chassis of the T-40 tank. This launcher became the main launcher for firing M-8 rockets and was in service until the end of the war. The chassis for the BM-8-48 was mainly the Studebaker and Ford-Marmon vehicles. (Fig. 101)

Chapter 4

Launchers for M-20, M-30 and M-31 rockets

The M-20 rocket launcher had the same caliber (132 mm) as the M-13, but significantly more weight. This did not allow launching such projectiles from the lower row of guides of the BM-13 installation due to the small margin of safety of the guides, and indeed of the entire installation. Therefore, it was decided to launch M-20 rockets from standard BM-13 and BM-13N launchers only from the upper guides. Thus, the number of missiles in a salvo has decreased from 16 to 8.

In May 1942, in the SKB of the Compressor plant, VA Rudnitsky's design group, on the instructions of the Main Armament Directorate of the Guards Mortar Units, developed a special frame-type launcher - the M-30 launcher for 300-mm M-30 rockets. This very simple launcher was based on German throwing devices mod. 1940 and 1941 , of which the Germans fired 28-cm and 32-cm rockets.

When firing, the M-30 launcher was installed directly on the ground and four shells were placed on it in a special seal ("box 30"). Inside the box there were guide strips along which the projectile glided when fired. In this capping, rockets came from factories and warehouses, and from it were launched. Then, according to proposals from the front, a two-row loading method was developed at SKB, which made it possible to fire 8 shells from each M-30 machine. Such machines began to arrive at the front in the spring of 1943. The density of the salvo has doubled. (Fig. 102)

To carry out the launch, on the inner surface of the cork, there were longitudinal wooden bars upholstered with metal strips, along which the shells slid during launch. From the end, the capping had a removable bottom, which ensured the unhindered exit of the projectile when firing. The machine was made in the form of a light tilting frame made of steel squares. Four closures with M-30 projectiles were laid on the frame in one row and secured with the help of removable ties. The frame in the lower part had openers that kept it from shifting during a volley. In front of the frame there was a removable vertical support, which gave the frame the necessary elevation angle for shooting. The direction of fire was set directly when the frame was installed in position. The firing was carried out by applying a pulse of electric current to the projectile through wires from a twin blasting machine. The machine served a group of launchers through an electrical distribution device ("Crab"). When changing positions, the launchers were manually loaded and transported on ordinary on-board vehicles.

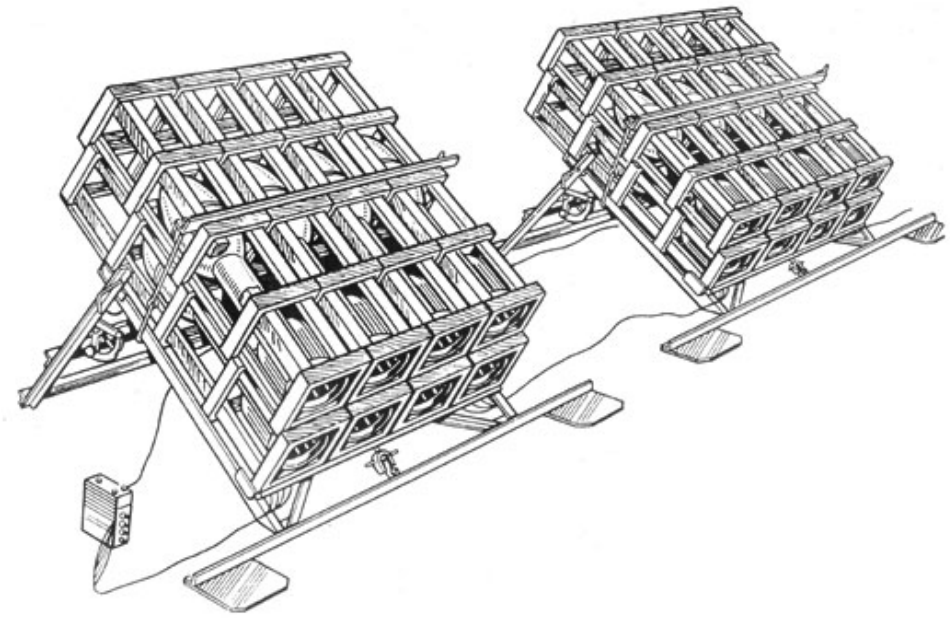


Fig. 102. Launcher (frame) M-30

The machines as starting devices had a number of advantages: simple design, low cost, and simplified loading process. But there were also significant drawbacks: low mobility, the complexity of horizontal and vertical guidance in a charged state, insufficient aiming accuracy, the possibility of an emergency descent of the projectile due to the entrainment of a poorly secured capping in flight. The short length of the guides led to an increase in the dispersion of projectiles. Installation of frames on positions, installation of capping with shells on them, their fastening, connection of electrical wires, giving an elevation angle, etc. required a significant amount of work. Due to the relatively short range of the M-30 shells, the position of the installations was chosen close to the front line, which increased the likelihood of their detection and destruction by the enemy.

By order of the State Defense Committee of June 8, 1942, after successful field tests, the M-30 launcher was put into service and put into mass production. The M-30 machines were widely used in 1942-1943 on all fronts when breaking through enemy defenses.

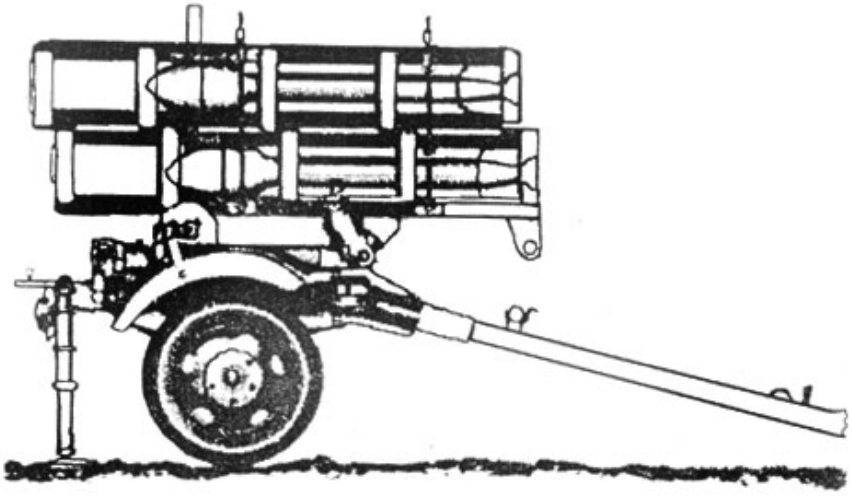
The M-30 machines were also used to launch M-20 high-explosive rockets, which had an explosive weighing 18.4 kg in the warhead. For this, six removable guides were placed on the frame of the M-30 machine. This made it possible to launch simultaneously six M-20 shells.

To launch the M-31 shells, the M-30 machines were initially used, and then, in October 1943, the M-31 machine was adopted, developed by the Main Armament Directorate of the Guards mortar units at the suggestion of Major Engineer N.N. Yurishev and manufactured by at the Burovaya Tekhnika plant.

In December 1943, the design group of VA Rudnitskiy SKV plant "Compressor" developed a more advanced 8-round launcher M-31 with two-row loading of shells. In January 1944, after field tests, the machine was put into service and successfully used by the troops at the final stage of the war.

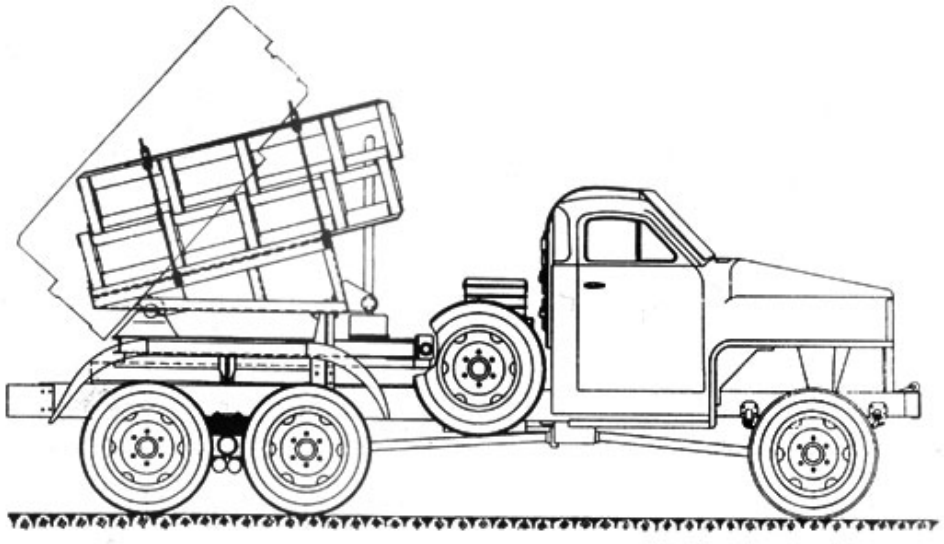
In May 1944, a 6-round M-31 launcher of lightweight type, similar in design to an 8-round machine, was adopted.
In 1943, a launcher for M-31 missiles on a trailer was designed, outwardly similar to a classic artillery system. A prototype was made, but the installation did not go into production. (Fig. 103)

Fig. 103. Launcher M-31 on a trailer



In January 1943, the SKB of the Compressor plant began work on the creation of a launcher for M-30 and M-31 projectiles on an automobile chassis.
The first experience was the installation of the M-30 machine on the chassis of a ZIS-6 vehicle. In February-March 1944, something similar was done on the Studebaker chassis. Factory seals of rockets were used as guides. The BM-31 prototype launcher was successfully tested and used in combat. The installation was equipped with a special set of charging device - a removable roller conveyor, snoring, rammer, etc. (Fig. 104)
In the same SKB, in March 1944, a BM-31-12 launcher was created for M-31 rockets on the chassis of the Studebaker car. Its distinctive feature was the launch of rockets not from a transport closure, but from a specially developed welded package - the so-called honeycomb guides. (Fig. 105)

Fig. 104. Launcher M-31 based on "Studebaker"



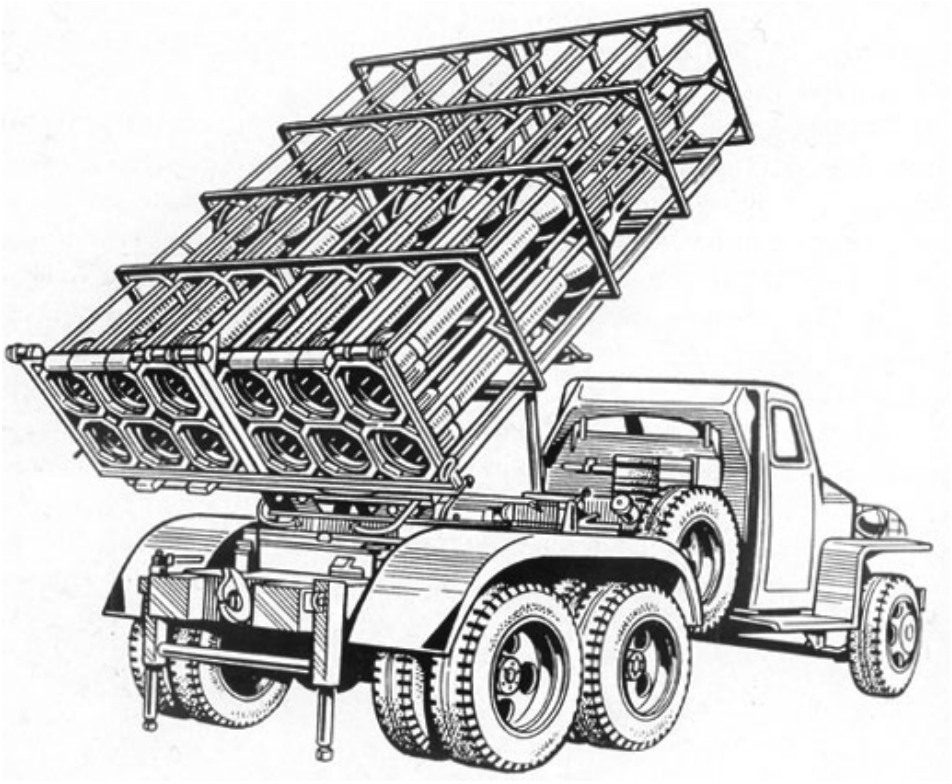


Fig. 105.12-charging self-propelled launcher BM-31-12

To lock the projectiles on the guides during the movement of the installation, a special device was developed, consisting of upper and lower transverse slats with pads for securing the projectile in front in the stowed position, two rear folding grates with plates and tensioning devices (for securing the projectile from the nozzle exit side) and a system levers that allow lowering or raising the reclining grates and thereby stopping or releasing the projectiles. At the same time, this device served as a lock, excluding spontaneous launch of the projectile in the stowed position of the installation.
Tests of the BM-31-12 launcher with honeycomb guides were carried out in April-May 1944. The purpose of the tests was to determine the combat effectiveness, strength, stability when firing and in the stowed position, ease of loading and maintenance, the correct placement of individual units and installation mechanisms. The tests showed high tactical and technical characteristics of the BM-31-12 launcher. The landfill report noted that firing from BM-13-12 with M-31 projectiles is possible and safe when the shooter is both in the cockpit and outside it. The BM-31-12 installation is stable not only with lowered jacks, but also with raised ones.

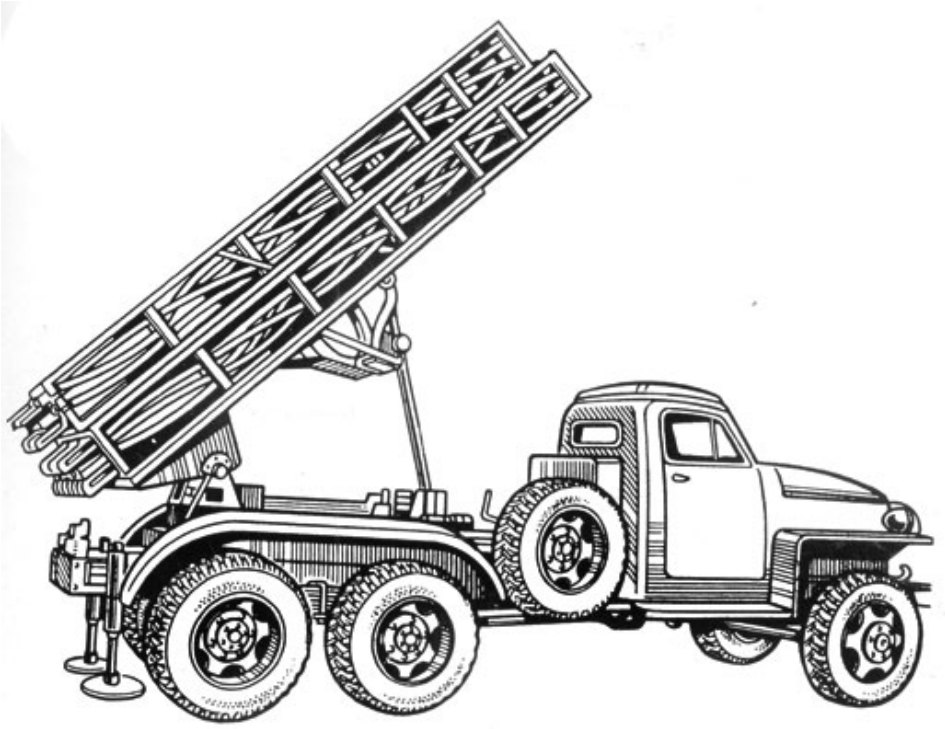
Chapter 5

Spiral Launchers

At the end of 1943, the design group of A.N. Vasiliev SKB of the Compressor plant, on the instructions of the Main Armament Directorate of the Guards mortar units, began developing a launcher for firing M-13UK (improved accuracy) and M-13- DD (extended range), as well as M-13 and M-20 projectiles.
In 1944, a 10-charge self-propelled launcher BM-13-CH was developed on the chassis of the Studebaker car. The main feature of this installation was that for the first time spiral (screw) guides were used in it, when moving along which the feathered rockets received rotation at a low angular velocity. This significantly increased their accuracy. When firing from the BM-13-SN launcher, the accuracy of the M-13-DD shells increased 1.5 times, and the M-13UK - 1.1 times compared to the accuracy when firing from the standard BM-13N launcher.
The spiral guide consisted of four rods: three rods made of smooth steel pipes, and the fourth was made of square steel. The fourth bar was the leading one and had a T-shaped groove for the projectile pins. All rods had a spiral shape, the angles of twisting were different in length. The mutual arrangement of the spiral-shaped rods gave the guide the shape of a rifled barrel, as it were. The inner diameter of this barrel was 132.8 mm, the rails were 4 m long, and the total helix angle of the rails was 480 ° along this length. The guiding cells were mounted in four cassettes, which were attached to the truss in two rows. The farm was a lattice platform welded from squares.

The truss, together with the package of guides, could be rotated in a vertical plane about the axis located in the sleeves of the swing frame brackets.
The lifting mechanism is screw type. By means of a lifting mechanism, angles from + 10 ° to + 45 ° can be attached to the package of guide cells.
The turning mechanism is screw. With the help of the swivel mechanism, it was possible to rotate the package of guides within 10 ° to the left and right of the central position.
The sight of the mount is taken from the 76 mm ZIS-3 cannon.
Thus, the design of the BM-13-SN launcher and its guides embodied the promising idea of improving the accuracy of firing of solid-propellant unguided rockets without loss of range, as was the case with the M-13UK and M-31UK shells rotating due to the outflow of gases. ...
The BM-13-SN installation has successfully passed field and sea trials and was put into serial production. In 1945, about 100 such installations were manufactured. They were armed with several units of rocket artillery. (Fig. 106, 107)

Fig. 106. Fighting vehicle BM-13-CH with spiral guides



Installation data BM-13-SN
Design data

Number of guide cells	10
Length of guide cells, m	4
Internal diameter of cells, mm	132.8
Angle HV, deg	-10 °; + 45 °
Angle HN, deg	± 10 °
Effort on the handle of the flywheel of the HN mechanism, kg	10-12
Effort on the handle of the flywheel of the HN mechanism, kg	10
Dimensions of the combat vehicle in the stowed position, mm:	
Length	6365
Width	2200
Height	3115
Weight summary, kg	
Pack of guide cells	1550
Artillery unit	2470
	6250

BM-13-SN in the stowed position without	
BM-13-SN	6680
projectiles in firing position: with M-13 or M-13UK	6880
projectiles with M-13-DD-1 projectiles	
Operational data	
Transition time from traveling position	1.5-2
in combat, min	3-5
Salvo time, s	
Loading time, min:	2.0-2.5
shells M-13 and M-13UK	3.0-5.0
shells M-13-DD-1	

In the middle of 1944, launchers with BM-31-SN spiral guides for M-31 rockets were created in the SKV of the Compressor plant.
In the same SKB in 1944, the design group of V.A.Rudnitsky developed a 32-charge launcher BM-8-SN with spiral guides for launching M-8 projectiles.
To test the guides by launching M-8 rockets, two-meter samples with a spiral steepness of 30, 50, 90, 135, 180 and 225 ° per one linear meter of length were developed and manufactured. Tests have shown that for the M-8 projectile, the least dispersion is provided at a twist angle of 180 ° per one linear meter.

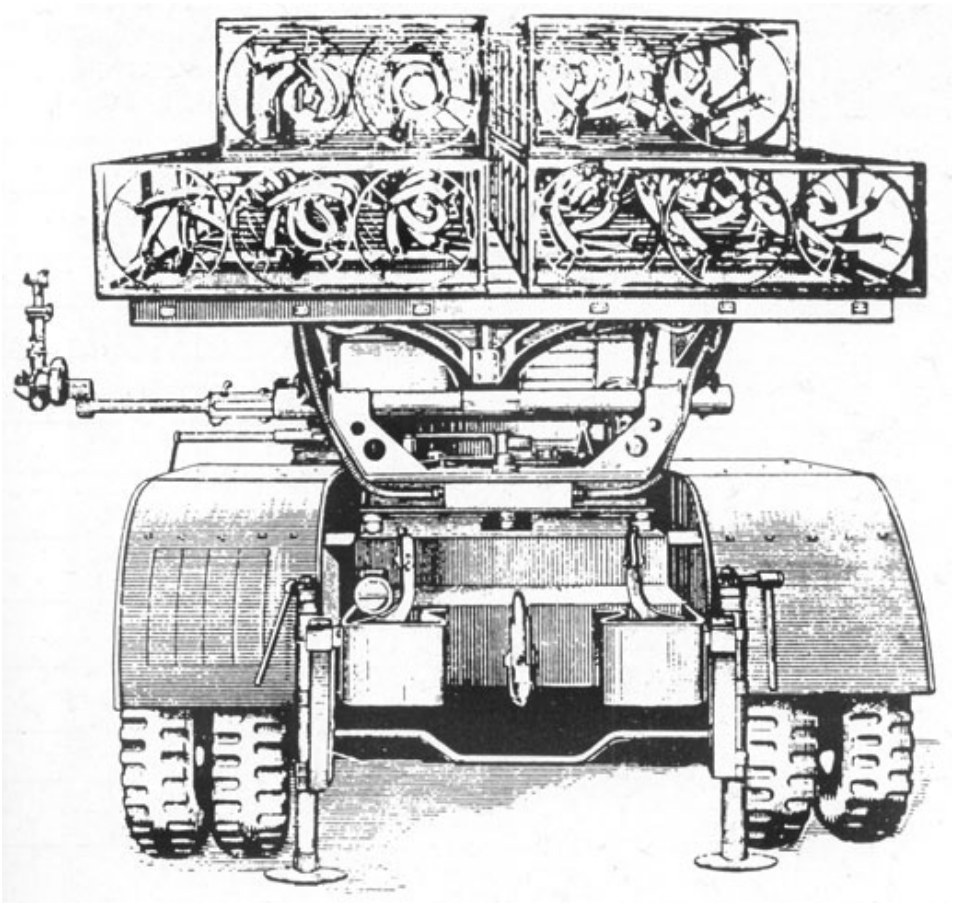


Figure: 107. Fighting vehicle BM-13-CH (rear view)

In late April - early May 1945, the BM-8-SN launcher was tested. Accuracy of fire with BM-8-CH M-8 projectiles increased 4-11 times. However, in connection with the end of the war and the removal of the M-8 projectile from production, the BM-8-CH launcher was not adopted for service.

Table 49

Main characteristics of self-propelled multiple launch rocket systems for ground forces (1941-1945)

Combat vehicles	BM-8-48	BM-13-16	BM-31-12
Car	GAZ-AA, ZIS-6, etc.	ZIS-6, "Studebaker"	Studebaker
Length of guides, m	25	five	3
Number of guides	48	16	12
Machine length in stowed position, m	6.1	6,7	6.2
Machine width, m	2.2	2,3	2.4
Machine height in stowed position, m	2.8	2.8	3.0
Weight in the stowed position without shells, kg	5485	7200	7100
Transition time from traveling to combat, min	1.5-2	2-3	3-5
Installation loading time, min	5-6	5-8	10-12
Volley duration, s	8-10	8-10	8-10
Effort on the handle of the lifting and turning mechanism, kg	6-8	8-10	8-10

Table 50

Chassis data for combat vehicles (1941-1945)

one	2	3	four	five	6	7	8
	Studebaker	Chevrolet	ZIS-6	GMC	"International"	Ford Marmont	Tractor STZ-5
Carrying capacity of the chassis, t	2.5	1.5	four	3	2.5	2.5	1.5
Number of driving axles	3	2	2	3	3	2	caterpillars
Fuel consumption per 100 km of track, kg	30.4	22.4	32.0	29.0	30.5	29.0	12.0 *
Cruising on the highway, km	250-280	250-280	160-190	?	?	?	?
Clearance, mm	248	250	290	?	?	?	?
Maximum engine power, hp from.	95	93	73	97	95	95	52
Rpm	2500	3100	2400	3000	2600	3600	1250
Fuel tank capacity, l	150	114	120	150	150	215	162

* For 1 hour of engine operation.

Chapter 6

Conversion of wartime launchers to new vehicle chassis

Combat vehicles on the chassis of foreign brands were in service until the end of the 50s. From the end of the 40s, the production of combat vehicles began:
- BM-13N on the chassis of the all-wheel drive vehicle ZIS-151 (index GRAU-U-9416); (Fig. 108, 109)
- BM-13NM on the chassis of the ZIL-157 vehicle (GRAU index - 2B7); -
- BM-13NMM on the chassis of the ZIL-131 vehicle (GRAU-2B7R index).

The artillery part of all these vehicles is exactly the same, with the exception of the B-13NMM, which had a step for the gunner.

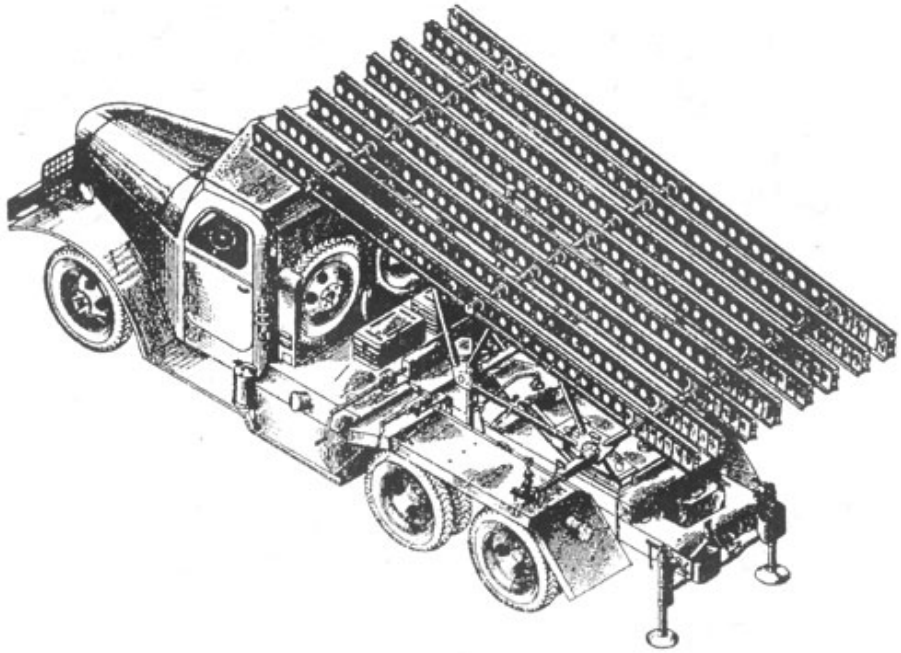


Fig. 108. Fighting vehicle BM-13N on the chassis of the ZIS-151

The ZIS-151 car has been mass-produced since 1949. Its engine power was 92 hp. from. at 2600 rpm. The maximum speed on the highway is 55 km / h. Fuel consumption was relatively high - 47-55 liters per 100 km.
The ZIL-157 car has been mass-produced since 1958. Its engine power was 110 hp. from. at 2800 rpm. The maximum speed on the highway is 60 km / h. Fuel consumption on the highway is 38.5 liters per 100 km at a speed of 30-40 km / h. The volume of the main tank is 150 liters, additional 65 liters.
The ZIL-131 car has been mass-produced since 1966. Its engine power was 150 hp. from. at 3200 rpm. The maximum speed on the highway is 80 km / h. Fuel consumption on the highway is 40 liters per 100 km at a speed of 30-40 km / h. The volume of the main tank is 170 liters, additional 170 liters.

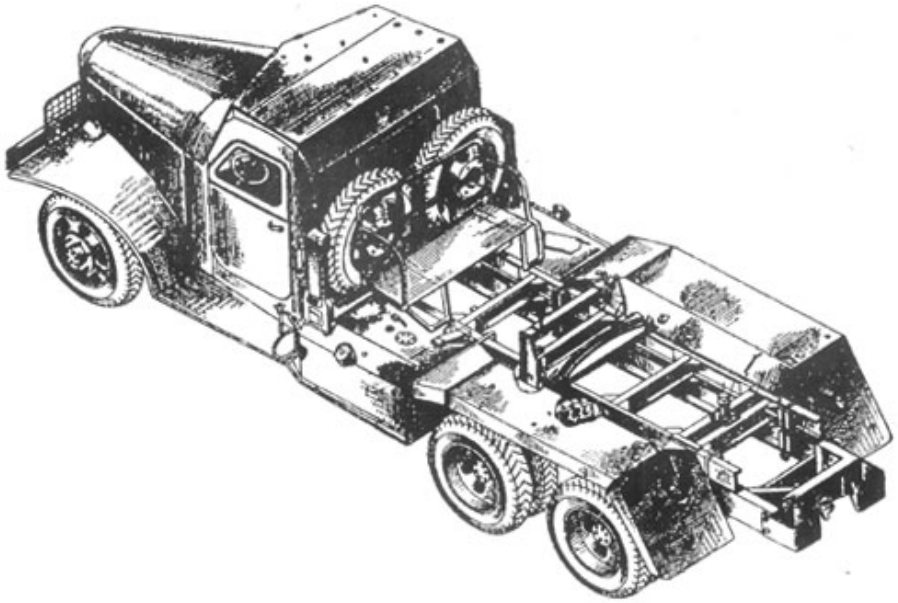


Fig. 109. Chassis of the ZIS-151 vehicle from the BM-13N combat mount

Fighting vehicles B-13N (U-9416), BM-13NM (2B7) and BM-13NMM (2B7R) could fire high-explosive fragmentation shells M-13, M-13UK and M-13UK-1.

By 1991, BM-13NMM combat vehicles were used as sighting and training vehicles in the Uragan MLRS regiments.

Combat vehicle data BM-13N

Number of guides	16
Length of guides, m	5
Angle HV, deg	+ 8 ± 1 °; + 45 °
Angle HN, deg	± 10 °
Effort on the handle of the lifting mechanism, kg	to 13
Effort on the handle of the swing mechanism, kg	to 8
Weight of the package of guides, kg	815
Weight of the artillery unit, kg	2350
Weight of the combat vehicle in the stowed position (without people), kg	7210 (7090, 8350) *
Weight of the combat vehicle in the combat position with shells, kg	7890 (7770, 9030) *
Length in the stowed position, m	7.2
Width in the stowed position, m	2.3 (2.33; 2.5) *
Height in the stowed position, m	2.9 (3.0; 3.2) *
Time to transfer from the traveling position to the combat position, min	2-3
Time required to load the combat vehicle, min	5-10
Time required for volley production, with	7-10

* In brackets are data for combat vehicles BM-13NM and BM-13NMM.

Since the end of the 40s, BM-31-12 combat vehicles were produced on the ZIS-151 chassis.

Data of the BM-31-12 combat vehicle on the ZIS-151 chassis

Design data	
Number of guide cells	12
Length of guides, m	3
Angle HV, deg	-10 °; + 48 °
Angle HN, deg	± 10 °
Effort on the handle of the HN mechanism flywheel, kg up to 12	up to 12
Effort on the handle of the flywheel of the HN mechanism, kg	up to 10
Dimensions in the stowed position, mm:	
length	7000
width	2500
height	3000
Weight summary, kg	
Package guides	700
Artillery unit	2170
BM-31-12 on the ZIS-151 chassis in a firing position with 12 shells	8500
in the stowed position	7100
Operational data	
Transition time from the stowed position to the firing position, min 3-5	3-5
Loading time, min	10-15
Salvo time, s	7-10

Chapter 7

Mining Launchers

In August 1942, the head of the mobile repair shops A.F. Alferov, officers X. Ya. Sulyaev and L.R. Reps of the Black Sea Operational Group of the Guards Mortar Units of the North Caucasian Front proposed to create a portable mountain launcher for 82-mm rockets. Installations of this type were supposed to be used in the defense of trails and passes in the Caucasus Mountains, inaccessible to field artillery and self-propelled rocket launchers.
In the explanatory note dated September 3, 1942 to the project of the mountain launcher, drawn up by Sulyaev and Reps, two options for installing the installation were proposed. According to the first version, the mountain launcher was mounted on "goats" (on a machine tool), according to the second - on a two-wheeled cart. In both versions, the installation

had 8 guides of the "flute" type with pyro pistols from the BM-8-36 launcher. Stops (coulters) were not provided on the units. The installations were simple in design, did not have a sight and independent guidance in azimuth. Shooting from the installations was carried out using a battery and a fire control device, operated remotely.
Both versions of the mining launchers were manufactured by the task force in mobile repair shops. Prototypes were tested by shooting. Tests have shown sufficient rollover stability and reliability of the launchers. For the command of the North Caucasian Front, a demonstration of firing from these experimental installations was carried out; the results were good.
Experienced mining launchers also had disadvantages: the need to further simplify their design and manufacturing technology was noted; the greatest difficulties were associated with the development of aiming and horizontal guidance nodes.
On September 5, 1942, the draft design of the "PC mining installation", executed by army specialists in the Caucasus, in two versions was sent for consideration to the commander of the guards mortar units V.V. Aborenkov. After getting acquainted with him in the Main Directorate of Armaments of the Guards Mortar Units, he was sent to the Compressor plant with a request “to very urgently develop a blueprint for a mountain launcher on the basis of this project”. Without waiting for the completion of the development of the installation, Aborenkov on September 19, 1942 ordered to send the designer of the SKB of the Compressor plant to the North Caucasus to work out the drawings of the installation created there and help in organizing production.
On September 21, 1942, a group of three people left for the Caucasus: a representative of the Main Directorate of Armaments of Guards Mortar Units NN Yuryshev, designer of the SKB of the Compressor plant F.I. A. Dobrokhotova.
After reviewing the prototype of the mining launcher, they made a number of fundamental changes to the design of the prototype. In the installation, the guides of the "flute" type were replaced by the guides of the "beam" type. The launcher was able to change the elevation angle and the ability to turn along the horizon, which was necessary in combat conditions. Instead of an electric method of firing with the help of a battery-powered fire control device, a more effective method of firing "fire communication" was used - with the help of a cartridge and a pistol. A number of other changes have also been made.
The introduction of the mechanical method of "fire connection" into the design instead of the electrical one was a fundamentally new technique. This made it possible to abandon the at that time super-deficient and heavy storage battery, fire control device and electric drive. Fire communication was carried out using two rows of tubes on the upper and lower row of guides, connecting the end cavities of the nozzles of the rockets. Each row of tubes had its own mechanical fuse. The fuses were combined into a single pistol - the igniter, into which two cartridges of a TT pistol cartridge with black powder instead of a bullet were placed. When pulling the check from the trigger of the pyro pistol, its two strikers hit the capsules of the cartridges inserted in it. The gunpowder in them ignited and set fire to the powder mass of the engines of two rockets - one in the top row, the other in the bottom. A hot stream of gases from the nozzles of the shells was directed through the tubes to the nozzles of the adjacent shells. The check from the ignition pistol was pulled out with a cord.
The modified mountain launcher was disassembled into three parts for ease of transportation. Its weight was 68.5 kg, of which 36.4 kg fell on four guides 970 mm long each, which replaced eight guides of the "flute" type, while the installation remained 8-round.
In the test report of the installation dated October 22, 1942, the following comments and suggestions were made: to rework the guide (simplify, lighten, strengthen); strengthen the rigidity of the legs of the base and connect them with an additional connection to the circle; increase the stability of the installation; strengthen the turntable ring.
The tests of the installation showed its high combat effectiveness. The mining launcher was approved by the Military Council of the Black Sea Group of Forces and handed over for production to auto repair shops and the Sochi and Sukhumi railway depot. On October 1, 1942, 48 installations were manufactured, of which 8 with an electric igniter and 40 with a fire link. They were combined into 12 M-8 mountain-pack batteries. (Fig. XXXII color insert)
In the SKV of the Compressor plant, according to the technical assignment of the Main Armament Directorate of the Guards Mortar Units dated December 2, 1942, the mining launcher was further improved. The terms of reference read: "... to produce, no later than December 15, 1942, one sample of the mining installation ..."
The mining launcher developed in the SKV of the Compressor plant was more advanced than the previously created ones. The developers managed to increase its stability, reduce the vertical aiming stability when launching rockets, reduce the weight of the installation to 51 kg and reduce its dimensions. The installation was disassembled into three parts: the lower one, in the form of a four-point folding arachnoid tripod; upper, in the form of a rack, turning horizontally at an angle of 45 °; a package of guides, the elevation angle of which could vary from 0 ° to + 48 °. The package had four double guides 1 meter long with trays attached to them, similar to serial guides of the "beam" type of the BM-8-24 launcher, but much lighter (Fig. 110).

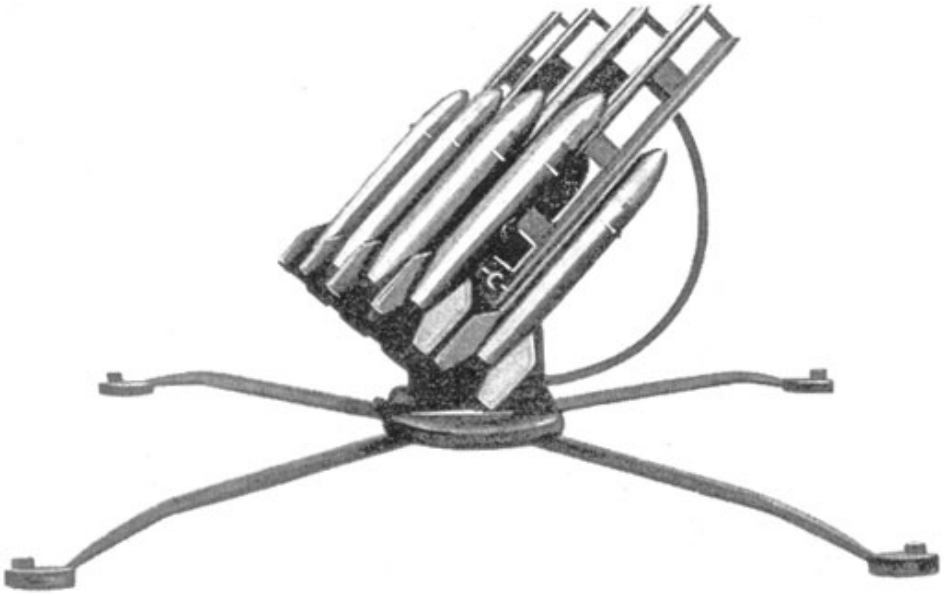


Fig. 110. Mining launcher for 82-mm M-8 projectiles

At the Penza Machine-Building Plant, a prototype of a mining launcher was manufactured according to the drawings of the Compressor plant. Installation tests were carried out from 12 to 26 July 1943. The unit was found to be robust, safe and easy to maintain. According to the test results, the mountain pack launcher was recommended for serial production and for adoption.
In 1944, during the fighting in the Carpathians, army craftsmen installed mountain launchers on Willys-type vehicles.

Chapter 8

Railway Launchers

On November 17, 1941, the head of TsKB-19 of the People's Commissariat of the Shipbuilding Industry appealed to GAU with a proposal to equip railway platforms with missile weapons. The proposal was approved. It was decided to mount 10 installations for launching 82-mm rockets on five biaxial 20-ton railway platforms and two installations for launching 132-mm projectiles on two of the same platforms.
In November 1941, the SKB of the Compressor plant was tasked with developing launchers for 132-mm and 82-mm rockets on two-axle 20-ton armored railway platforms. These installations were intended for the defense of Moscow. The creation of such installations on railway platforms for that time was a completely new engineering challenge. When designing them, many complex issues had to be taken into account and solved in a short time: determining the number of guides and their relative position on the platform for each missile caliber; creation of rotary devices of installations, allowing to conduct a circular shelling; protection of platforms and installation elements from hot gases flowing out under pressure during missile launch; ease of loading and maintenance of installations; possible maximum speed of movement and braking of the platform;
The development of launchers on railway platforms and their manufacture were carried out in the conditions of the evacuation of the Compressor plant. The SKB of the plant remained in Moscow to fulfill this task. It was not possible to manufacture artillery parts of the installations, therefore artillery parts from standard BM-13 launchers on the STZ-5 tracked tractor, BM-8 on the ZIS-6 and BM-8-24 on the T-40 tank were used. For the base of artillery units, requiring a circular turn in azimuth, ball straps of the tank type were required to rotate the towers. It was also impossible to get them. For this purpose, it was necessary to use bandages of locomotive wheels and make ball shoulder straps from them (as was the case in the civil war for the installation of 76-mm guns Model 1902 on armored trains).
SKB has developed three launchers on armored railway platforms: 16-round for 132-mm M-13 rockets, 48- and 72-round for 82-mm M-8 * missiles. According to the drawings developed at the SKB, in December 1941, five launchers were manufactured on armored railway platforms: three for launching M-13 rockets, and two (48-round) for launching M-8 shells. The installations took part in the battle for Moscow. (Fig. 111, 112)

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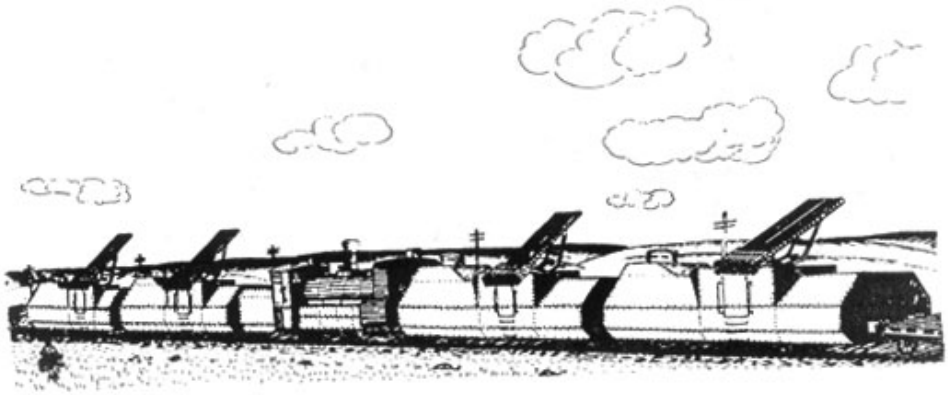
* The 82mm missile launcher had the largest number of guides (72) among field launchers designed during World War II.
In March 1942, armored trains No. 659 "Kozma Minin" and No. 702 "Ilya Muromets" were given one armored platform each with M-8-24 launchers.

On August 12, 1942, two armored platforms with four M-8 launchers were transferred to the 62nd separate division of armored trains (armored trains No. 653 "Michurinets" and No. 701 "Soviet Armenia").
At the same time, armored platforms with launchers of 132-mm M-13 projectiles were attached to armored trains No. 686 and No. 697 of the 57th separate armored train division.

Fig. 111. A separate division of railway PU BM-13-16



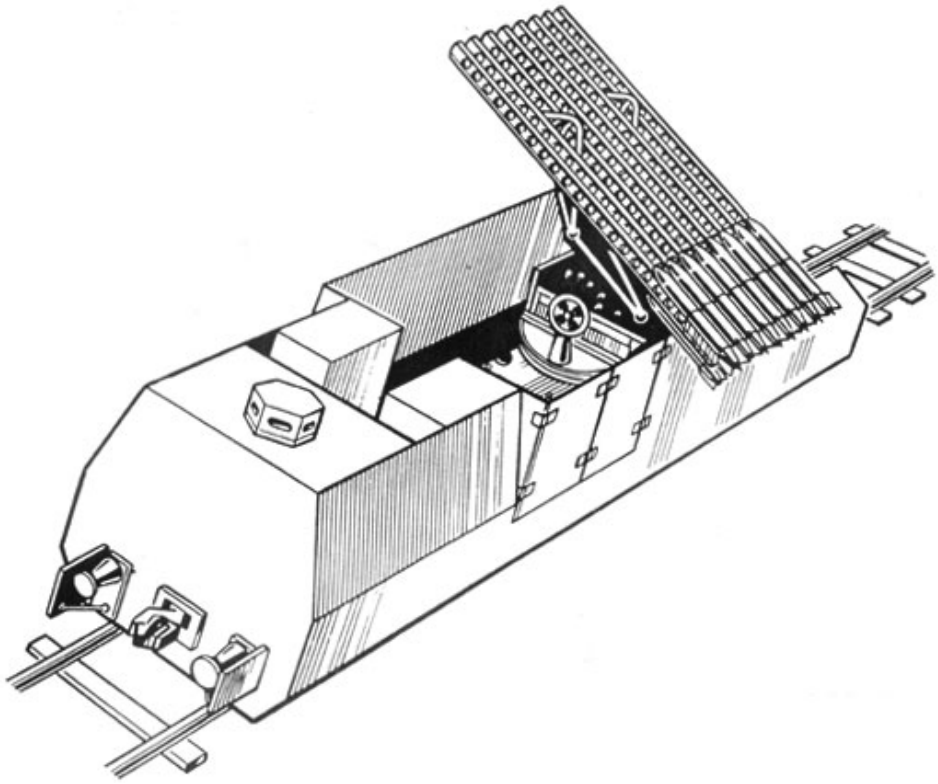


Fig. 112. Launcher for RS-132 mm on an armored railway platform

At the end of 1942, launchers PU-8, mounted on railcars, were created. These installations were intended to launch 82-mm M-8 missiles and had 12 guides.

Chapter 9

Jet Plants in the Navy (1942-1945)

In February 1942, the Navy's Art Directorate issued a technical assignment for the SKV plant "Compressor" for the design of shipborne artillery installations for rockets M-13 and M-8. The development of these projects was completed by the SKV under the leadership of V.P. Barmin in May 1942.
The M-8-M installation provided the launch of 24 82-mm M-8 projectiles in 7-8 seconds. The M-8-M installation was of a tower-deck type and consisted of an oscillating part (a block of guides on a farm), an aiming device, guidance mechanisms

and electrical equipment. The swinging part with the help of the swing axis and the supporting screw of the vertical guidance mechanism was pivotally fixed on the base of the installation and could change the elevation angle within the range from + 5 ° to + 45 °. A rotary device with a ball shoulder made it possible for the rocking part of the installation to be rotated 360 ° horizontally. On the rotary part of the base of the installation, in its above-deck part, guidance mechanisms, sighting and braking devices, a gunner's seat (aka shooter), a firing device and electrical equipment were attached. (Fig. 113)

The M-13-MI installation provided the launch of 16 M-13 projectiles from eight I-beams (beams) in 5-8 seconds.

The M-13-MI installation was of the above-deck type and could be mounted on the roof of the conning tower of an armored boat (at the suggestion of SKV) or installed instead of the aft artillery tower of Project 1124 armored boats.

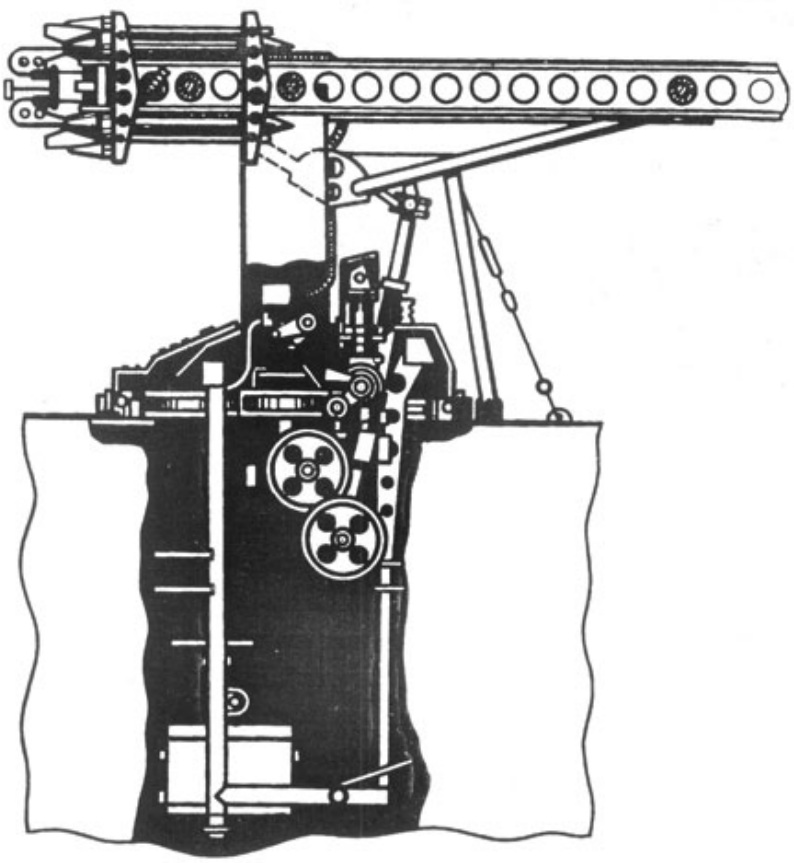


Fig.113. General view of the M-8-M marine rocket launcher

In May 1942, the first M-13-MI unit was sent from the Compressor plant to the city of Zelenodolsk, where it was installed on a Project 1124 armored boat. A little later, the M-8-M unit was delivered to Zelenodolsk. The prototype M-1-13MI installation was installed on the BKA armored boat No. 41 (from August 18, 1942 - No. 51; serial No. 314) of project 1124, and the prototype M-8-M installation was installed on the BKA armored boat No. 61 (serial No. 350) project 1125. The test report of the M-13-MI installation on armored boats was approved on July 17, 1942. (Fig. 114, 115)

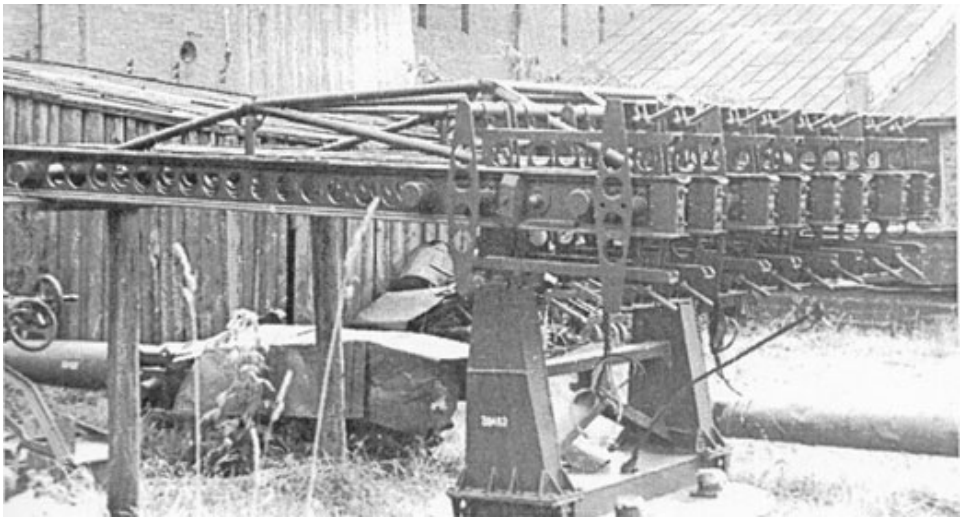


Fig. 114. Launcher of M-13-M missiles, taken from an armored boat

By order of the People's Commissar of the Navy on November 29, 1942, the M-8-M and M-13-MI rocket launchers were put into service. The industry

received an order for the manufacture of 20 M-13-MI units and 10 M-8-M units. (Fig. 116)
In August 1942, the M-13-MII launcher for 32 132-mm M-13 projectiles was manufactured at the Compressor plant. The M-13-MII installation was of a tower-deck type, its design scheme is similar to that of the M-8-M launcher. In Zelenodolsk, the M-13-MII launcher was mounted on the BKA # 315 armored boat of Project 1124 instead of the aft artillery tower. In the fall of 1942, the M-13-MII installation was tested on an armored boat and was recommended for adoption. However, it was not accepted into service, and the prototype remained in the Volga flotilla.

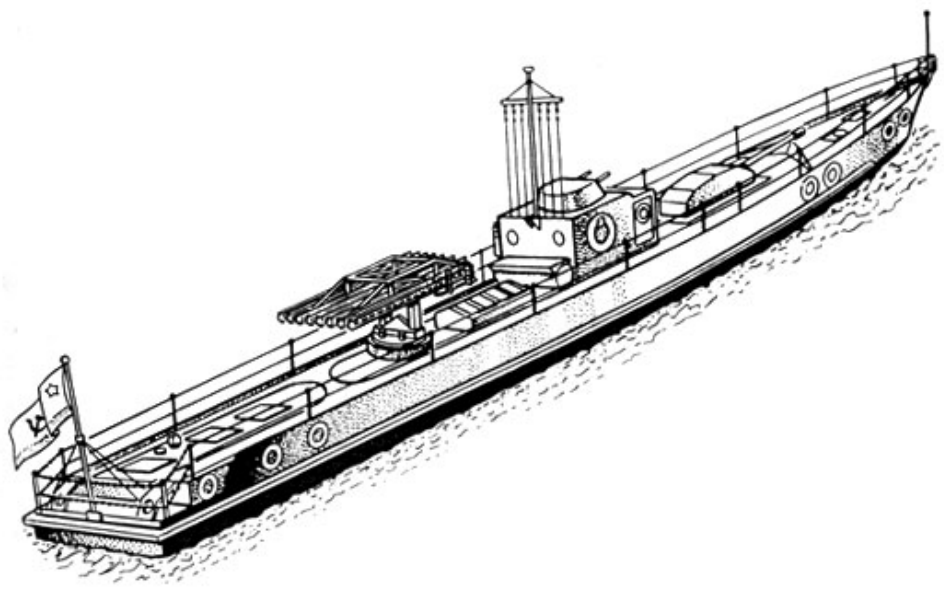
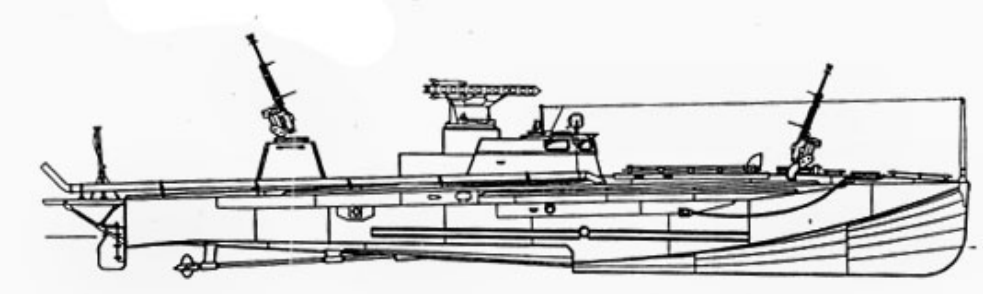


Fig. 115. Launcher for RS-132 mm on an armored boat

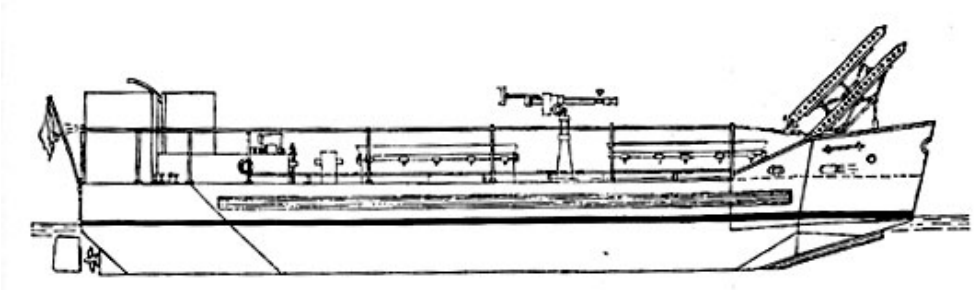
In the fall of 1942, 10 delivery boats of the Ya-5 type ("Yaroslavets") with a displacement of 23.4 tons were equipped with M-8-M rocket launchers. The TsKB-32 branch at plant No. 640 has developed options for arming torpedo boats with M-8-M rocket launchers. The lead boat according to project 213 was built at the Tyumen plant No. 639 and sent for testing in the city of Poti. On May 5, 1943, the boat was adopted and received the name "Moscow artisan of labor reserves". By July 1943, five more such boats had been commissioned by the Black Sea Fleet. Their launchers had 24 guides.
The combat operation of the M-8-M and M-13-M launchers on the seas, rivers and lakes revealed a number of their design flaws. Therefore, in July-August 1943, the Design Bureau of the Compressor plant began designing three shipboard launchers of the improved type 8-M-8, 24-M-8 and 16-M-13. The projected installations differed from the previous ones in more reliable stopping of rockets on guides in a storm at sea; increasing the speed of aiming the installation at the target; by reducing the efforts on the handwheel handles of the guidance mechanisms. An automated firing device with foot and manual control was developed, which allows firing single shots, bursts and volley fire. Sealing of the rotary device of installations and their attachment to the decks of the ship was ensured.
The artillery department of the Navy proposed to shorten the length of the guides for 132-mm projectiles from 5 to 2.25 m. However, experimental firing showed that with short guides, the dispersion of the projectiles is very high. Therefore, on the 16-M-16 launchers, the length of the guides was left the same (5 m). The guides of all the launchers used on the armored boats were I-beams.
Work on the 82-mm M-8-M launchers at the direction of the customer (the Navy Art Department) was discontinued at the preliminary design stage.
In February 1944, the SKV of the Compressor plant completed the development of working drawings for the 24-M-8 unit. In April 1944, plant 740 produced two prototypes 24-M-8. In July 1944, the 24-M-8 units successfully passed ship tests on the Black Sea. On September 19, 1944, the 24-M-8 installation was adopted by the Navy.
Working drawings of the 16-M-13 rocket launcher, designed to launch 16 M-13 missiles, were completed by SKV in March 1944. The prototype was manufactured by the Sverdlovsk plant number 760 in August 1944. Ship tests 16-M-13 took place on the Black Sea in November 1944. In January 1945, the 16-M-13 launcher was adopted by the Navy.
In total, during the Great Patriotic War, the industry manufactured and supplied to the fleets and fleets 92 M-8-M installations, 30 M-13-MI installations, 49 24-M-8 installations and 35 16-M-13 installations. These systems were installed both on armored boats of projects 1124 and 1125, and on torpedo boats, patrol boats, captured German landing barges, etc.

Fig. 116. Artillery boat AKA-5 based on the torpedo boat G-5 with the installation of M-8-M



Since the beginning of 1942, self-made launchers have been proactively installed on ships and boats. So, at the beginning of 1942, senior lieutenant G.V. Ternovsky and military engineer 3rd rank NS Popov designed lattice launchers for M-8 missiles. These installations were hung on the ship's guns. Guidance of installations was carried out by the guidance mechanisms of the gun itself. The first two installations were attached to 45 mm 21-K cannons on the MO-084 boat. Experimental firing from a boat was carried out on March 2 and 4, 1942 near Anapa in the presence of Admiral G. N. Kholostyakov. In the summer of 1942, three G-5 torpedo boats of the Black Sea Fleet were supplied with 4-6 homemade guides for launching 82-mm M-8 missiles. (Fig. 117)
At the beginning of 1943, at the initiative of Senior Lieutenant G.V. Ternovsky, twelve 8-charge launchers 8-M-8 were delivered to the Black Sea boat minesweeper KATSH-606 "Mackerel". It is curious that the "Mackerel" before the war was a fishing boat with a wooden hull, its displacement was only 32 tons. Nevertheless, the "Mackerel" several times struck at German positions in the Novorossiysk area. (Fig. XXXIII color insert)

Figure: 117. Launcher M-8
at a big tender,
used on
Lake Onega and the Baltic Sea



They put "homemade products on the knee" and on armored boats. For example, in the winter of 1942-1943, self-made launchers were made for 82 -mm shells M-8. The simplest steel rail guides were hung on the barrels of the 7b-mm F-34 cannons. A rail was placed on top of each barrel and attached to it with clamps for launching one projectile.
Both armored boats fired several times with M-8 shells on the enemy coast, and after the shells were fired, the guns could fire normally. And once, according to the recollections of the battalion commander V.V. Chudov, the BKA-101 armored boat, located north-west of Lavensaari Island, fired two M-8 shells at a German small destroyer of type T.
There was little use from "homemade products on the knee" at sea. * Their accuracy of fire was very poor, and the installations themselves "did not provide security", that is, they posed a greater danger to the team than to the enemy. In connection with this, the order of the People's Commissar of the Navy of January 24, 1943 prohibited the design and manufacture of rocket launchers without the knowledge of the Main Naval Staff of the Navy.

* Another issue is the use of homemade missile launchers on land, especially during street fighting, where they were literally irreplaceable.

Installation	***24-M-8***	***16-M-13***
Projectile caliber, mm	82	132
Number of guides	24	16
Length of guides, m	2	4
Loading time of installation, min	4-8	4-8
Duration of salvo, s	2-3	2-3
Elevation angle, degrees	-5 °; + 55 °	-5 °; + 60 °
Horizontal guidance angle, degrees	360 °	360 °

Combat crew, pers. : when firing	2	
when loading	2-3	3-4
Unit dimensions, mm:		
length	2240	4000
width	2430	2550
height	1170	2020
Unit weight without shells, kg	975	2100

To what extent was it expedient to install launchers with M-8 and M-13 rockets on armored boats? In the author's opinion, this is a moot point. The boats of project 1124, when installing jet weapons, had their artillery power halved. The draft 1125 boats significantly increased the draft and dropped the speed. The missile launchers were not armored; their loading and guidance was carried out by servants, not protected from enemy fire. Finally, even one bullet hitting a rocket on the launcher could kill the boat. In fact, after the installation of jet weapons, the launch boat ceased to be an armored boat. All the same installations for rockets were installed on other sea and river vessels of almost all types, from crew and torpedo boats to fishing seiners. Therefore, in the author's opinion, it was more expedient to place rockets on unarmored ships and boats, and armored boats were to be used as purely artillery ships. Another question is that in the absence of other watercraft there was no other way out.

Chapter 10

Rocket Artillery in the Great Patriotic War

The first Iodine missile battery under the command of Captain I.A.Flerov left for the front on the evening of July 1, 1941. The battery contained seven BM-13 installations, manufactured by NII-3, and one 122-mm howitzer (for sighting).
On July 14, at 1515 hours, by order of the chief of artillery staff of the front, Major-General of Artillery GS Kariofilli, the battery fired a volley at the accumulation of Nazi manpower and tanks in the Orsha region. The second volley of 94 shells was fired at 17:20. The firing was carried out from six launchers, since on the seventh the electrical cable from the firing control panel to the pyro contacts of the shells was damaged.
The appearance of Captain Flerov's battery at the front came as a complete surprise to the leadership of the Abwehr and the Wehrmacht. On August 14, the main command of the German ground forces notified its troops: “The Russians have an automatic multi-barreled flamethrower cannon ... The shot is fired by electricity. During the shot, smoke is formed ... When capturing such guns, report immediately. " Two weeks later, a directive appeared, entitled "Russian Cannon Throwing Rocket-Like Shells." It said: “... the troops are reporting on the use of a new type of weapon by the Russians, firing rockets. A large number of shots can be fired from one installation within 3-5 seconds ... Each appearance of these weapons must be reported to the general in command of the chemical forces under the high command on the same day. "
On the 20th of July 1941, a second battery of rocket artillery consisting of nine BM-13 launchers arrived at the Western Front, which entered the subordination of the 19th Army, and the third battery of three BM-13s was assigned to the 16th Army. During August and September, five more batteries of rocket artillery were sent to the active army.
On July 22, a rocket artillery battery was sent to the Leningrad front. It was commanded by Lieutenant P.N.Degtyarev. The battery consisted of four BM-13 launchers (two fire platoons), a control platoon and an ammunition platoon. It consisted of 50 trucks carrying 1,500 shells. The first salvo was fired on August 3 at 22 o'clock exactly at the Luga defensive line against the accumulation of fascist troops in the Kingisepp area. Subsequently, the units and units of the rocket artillery of the Leningrad Front were formed in the conditions of besieged Leningrad, in which mass production of BM-13 installations was established at the Karl Marx plant, and the production of rockets at the MI Kalinin plant No. 4.
In the course of the combat use of rocket artillery batteries, it became clear that the density of one salvo (2-3 shells per hectare) is insufficient to reliably defeat enemy manpower and fire weapons. The calculation for the use of a 122-mm howitzer as a sighting weapon was also not justified. For M-13 rockets, zeroing had no practical meaning.
Therefore, at the end of July 1941, the Supreme Commander-in-Chief decided to immediately transfer rocket artillery to a new organization. The regiment became its main organizational unit. At the same time, units were created, armed with BM-8 combat mounts and 82-mm M-8 shells along with BM-13 vehicles and M-13 shells.
By order of the Supreme Commander-in-Chief of August 8, 1941, the formation of the first eight regiments of rocket artillery began. This was an important milestone in her history. The new formations were given the name of the guards mortar units of the reserve of the Supreme High Command, which emphasized the exceptional importance attached to jet weapons.
The same order assigned the personal responsibility of the commanders of the fronts and armies for taking the necessary measures to preserve the secret of the new weapon and to prevent its capture by the enemy.
According to the staff organization, each guards mortar regiment consisted of three M-13 or M-8 divisions. The division had three batteries, and the battery had four combat installations. In addition, the regiment included an anti-aircraft

division and support units. But due to an acute shortage of anti-aircraft weapons, many missile units left for the front without them.

The regular organization of rocket artillery on the basis of the regiment provided a sharp increase in the density of rocket fire. The salvo of the M-13 regiment consisted of 576, and the M-8 regiment - of 1296 rockets.

The formation of the guards mortar units proceeded very quickly. Already on August 12, a division of one of the newly created regiments went to the front, and on August 19, two more divisions followed him. By September 12, the formation of all eight regiments was completed - the task of the Supreme Commander-in-Chief was completed in a month. Until the end of September, another, ninth in a row, regiment was created.

However, at the request of the commanders of the fronts, mainly the Western one, to reinforce each rifle division operating in the main direction with at least one M-13 or M-8 battalion, they began to reorganize a significant part of the Guards mortar regiments into separate divisions. In total, in November-December 1941, ten of the fourteen regiments were reorganized into separate divisions directly on the fronts. In addition, 28 new separate divisions were formed during the same period.

Separate divisions had two batteries of four combat installations each, that is, a total of eight installations. At the same time, the formation of three-battery separate divisions was begun, armed with BM-8 and BM-13 combat installations (12 per division), mounted on the chassis of T-40, T-60 tanks and STZ-5 tractors, for combat operations in wooded - swampy terrain.

By December 1, 1941, the total number of units of field rocket artillery was 7 regiments (of which three M-13 and four M-8) and 52 separate divisions. They were armed with 356 BM-13 combat mounts and 231 BM-8 combat mounts, a total of 587 units.

By December 6, 1941, near Moscow, the Kalinin Front had two divisions of guards mortar units, the Western Front - 34 divisions and the South-Western Front - 12 divisions, a total of about 500 combat vehicles.

During the Moscow offensive, a "shell famine" arose in our units. This led to a decrease in the effectiveness of the "guards mortars". For example, in the 50th Army, 0.5 ammunition per gun and one divisional salvo for field rocket artillery were planned for two days of battle. The rockets were delivered to the front line directly from the manufacturing plants. On the night of December 7, 1941, two divisional salvos of mines for field rocket artillery were delivered to the 50th Army (in the Tula region) on the night of December 7, 1941 on seven transport aircraft. The next night, 3.5 divisional salvo of jet mines arrived there by road.

	01.12.1941	***05/01/1942***	***10/15/1942***
M-8 and M-13 combat mounts	587	1720	2592
M-20 missiles	-	-	4560

In November and December 1942, individual M-30 divisions, and then the M-30 regiments, began to be brought together into brigades of four or six divisions each. In total, by the end of the year, 17 brigades were formed, which were called the M-30 heavy guards mortar brigades.

At the beginning of December 1942, the formation of heavy guards mortar divisions of field rocket artillery began, consisting of two M-30 brigades, four M-13 regiments, a division headquarters and a command battery. The division had 96 BM-13 combat mounts and 576 M-30 frames in service with the division. The division's salvo consisted of 1536 M-13 mines and 2304 M-30 mines, a total of 3840 mines with a total weight of 230 tons.

During December, the 1st, 2nd, 3rd and 4th heavy guards mortar divisions were formed, which included eight M-30 brigades (out of 17) and 16 M-13 regiments, partly formed again and partly from among those who were on the fronts ... The divisions were sent to the Northwestern (1st), Donskoy (2nd and 3rd) and Voronezh (4th) fronts. In January 1943, two more divisions were formed (5th and 6th), and the formation of the 7th division (last) began, completed in February.

However, the very first use of divisions in battle showed that the combination in one formation of such units, different in tactical and technical characteristics of weapons, as the M-30 and M-13 divisions, did not justify itself. Therefore, such an organization was abandoned and switched to uniform armament of divisions.

In February 1943, the reorganization of the guards mortar divisions of rocket artillery into new states began. The division included three M-30 brigades, each of which had four fire divisions (72 frames per division). The division's salvo (864 frames, 3456 M-31 mines) with a total weight of about 320 tons was 1.4 times heavier than in the previous division.

Since the spring of 1943, M-30 units began to use a two-row method of stacking shells on the M-30 frames (8 shells instead of 4), as a result of which it became possible to halve the number of M-30 frames in a division (36 instead of 72), but the number of shells in their volleys remained the same.

As the breakthrough artillery corps was formed, the guards mortar divisions of field rocket artillery were included in these corps. On June 1, 1943, the 3rd Guards Mortar Division was part of the 2nd Artillery Breakthrough Corps, the 2nd Corps in the 7th Corps, and the 5th in the 4th Corps. The remaining four divisions (the 1st with one brigade, the 4th and 6th, each

with two brigades, and the 7th with three brigades) still remained in Moscow for reorganization and replenishment. The brigades of these divisions received only 36 eight-shot M-30 frames per division.

In addition to the brigades that are part of the guards mortar divisions, there were separate brigades in the artillery of the RVGK. On June 1, 1943, in the field rocket artillery, there were 17 brigades as part of the guards mortar divisions and 8 separate brigades. Four brigades in the divisions were still missing. The formation of units of heavy field rocket artillery continued.

On June 1, 1943, as part of the field rocket artillery of the RVGK, there were 7 divisions and 8 separate brigades M-31, 114 regiments (of which 20 regiments M-8, 94 regiments M-13) and 31 separate divisions (including 12 divisions M -8 and 19 divisions M-13). In service with all these formations and units there were 2536 combat installations and 5695 M-31 frames against 2884 combat installations and 5760 frames laid down by the state.

Excluding what was allocated to the corps and army artillery and what was formed for them, the same 7 divisions, 8 separate brigades, 104 separate regiments (13 M-8 regiments and 91 M-13 regiments) and 21 a separate division (8 separate M-8 divisions and 12 separate M-13 divisions), which had 2325 combat installations and 5695 frames. Compared with the data at the end of the first period of the war, the amount of available weapons in the units and formations of the RVGK increased by about 17% in terms of combat installations and by 25% in terms of frames. Thus, despite the fact that a significant number of units were allocated to corps and army artillery from the RVGK rocket artillery during the campaign in question (April-June 1943), its number continued to increase.

By June 1, 1943, the cavalry corps had 84 M-8 launchers and 48 M-13 launchers, but in fact there were 32 and 37. The rocket artillery rifle corps had no rocket artillery. See *Table 51.*

By the middle of 1943, the number of formations and units of field rocket artillery reached the level at which, in the situation of that time, it satisfied the needs of the fronts in it. The need to speed up its further numerical growth has disappeared. Therefore, during the summer-autumn campaign of 1943, there were no significant changes in the number of units and formations of this type of artillery. Remaining the same seven

Table 51

The composition of the field rocket artillery of the RVGK, army and corps on January 1, 1944

Artillery types	Number of connections and parts										Total in calculated shelves
	division M-31	division brigades	separate brigades M-31	total brigades	shelves M-8	shelves M-13	total regiments	dep. divisions M-8	dep. divisions M-13	total dep. divisions	
Artillery RVGK	7	20	thirteen	33	eleven	91	102	3	one	four	235
Army artillery	-	-	-	-	one	five	6	-	-	-	6
Corps artillery	-	-	-	-	7	-	7	five	29	34	eighteen
Total	7	thirty	thirteen	33	19	96	115	8	thirty	38	259

divisions, but the number of brigades in them increased from 17 to 20. The number of individual M-31 brigades increased from 8 to 13. The number of M-13 regiments increased by two, and M-8 regiments decreased by one. The number of individual M-13 divisions, formed for tank and mechanized corps, increased from 19 to 30, and individual M-8 divisions decreased from 12 to 8. In general, the M-8 regiments and divisions, as less powerful, were gradually re-equipped with BM-combat installations. thirteen. The main attention in the second half of 1943 was paid to the provision of corps artillery units with rocket artillery for tank, mechanized, cavalry corps and the development of heavy field rocket artillery formations as a more effective means of artillery support for breaking through enemy defenses in offensive operations.

During the period from July 5 to December 31, 1943, two divisions M-31 (4th and 7th), 8 separate brigades M-31, 11 regiments M-8 and M-13 and 6 were sent to the fronts from the training camp regiments M-8 (three-battery composition) for cavalry corps.

By the end of the campaign, almost all units and formations of rocket artillery, with the exception of 1 division, 15 separate regiments and 5 divisions located in the rear and having only 8-9% of available rocket artillery weapons, were on the fronts. As of January 1, 1944, all formations and units of field rocket artillery were armed with 2.7 thousand BM-8, BM-13

and 5.3 thousand M-31 frames against 2.3 thousand installations and 5.7 thousand frames for June 1, 1943.

Table 52

Armament of rocket artillery RVGK, army and corps on January 1, 1944

Weapon name	Artillery RVGK		Army artillery		Corps artillery		Total		Staffing (%)
	by state	on the face	by state	on the face	by state	on the face	by state	on the face	
Combat installations BM-8 BM-13	 396 2088	 364 1839	 24 120	 23 109	 120 236	 102 219	 540 2444	 489 2167	 91 89
Total	2484	2203 *	144	132	356	321	2984	2656	89
Frames M-31	4752	5335	-	-	-	-	4752	5335	112
Total	7236	7538	144	132	356	321	7736	7991	103

* In addition, the RVGK ground artillery armored trains had 8 BM-8 and 4 BM-13.

In April 1944, the troops began to receive M-13UK and M-31-UK shells with improved accuracy.

Table 53

Armament of formations and units of corps artillery on June 1, 1944

Weapon name	Cavalry corps		Tank and mechanized corps		Total		Staffing (%)
	by state	on the face	by state	on the face	by state	on the face	
M-8	84	80	-	-	84	80	95
M-13	-	12	288	285	288	297	103
Total	84	92	288	285	372	377	102

Table 54

Armament of formations and units of army artillery on June 1, 1944

Weapon name	Artillery of tank armies		Total		Staffing (%)
	by state	on the face	by state	on the face	
BM-13	144	125	144	125	87

From June 1944, BM-31-12 machines began to arrive for the M-31 and M-31UK missiles.
From September until the end of 1944, seven BM-31-12 brigades were formed and six were reorganized from the M-31 brigades. Twelve such brigades were included in the seven-brigade artillery breakthrough divisions. Eight of them were already in the divisions by January 1, 1945, and four were in the stage of formation. One brigade (as part of one division) remained in the Moscow training camp as a base for combat training of the units being formed.

Table 55

Armament of formations and units of artillery RVKG on June 1, 1944

Weapon name	Number of weapons		Staffing (%)
	by state	on the face	
BM-8	324	417	129
BM-13	2144	2117	99
Frames M-31	4752	5694	120
Total	7220	8228	114

According to the staff, the M-31-12 brigade consisted of three fire divisions, 12 combat units in each, a park division and rear units.
Starting from June 1944, BM-31-12 combat vehicles were re-equipping brigade divisions equipped with M-31 frame mounts - one division in each brigade. By the end of 1944, in all 27 brigades, one division was re-equipped with BM-31-12 installations. *See Tables 56-59* .
The composition of the field rocket artillery of the RVGK during the January-May 1945 campaign decreased by five regiments, transferred to the army artillery of tank armies (two regiments) and to the corps artillery of the 9th Guards Army (three regiments).
During the campaign, rocket artillery units continued to replace the M-31 frames with BM-31-12 combat mounts. 20 divisions were rearmed, as a result of which the number of BM-31-12 divisions in divisional brigades and individual brigades increased to 84.

Table 56

Armament of formations and units of corps artillery on January 1, 1945

Weapon name	Cavalry corps		Tank and fur. corps		Total		Staffing (%)
	by state	on the face	by state	on the face	by state	on the face	
BM-8	84	83	-	-	84	83	99
BM-13	-	12	296	274	296	286	97
Total	84	95	296	274	380	396	97

Table 57

Armament of formations and units of army artillery on January 1, 1945

Weapon name	Artillery of tank armies		Staffing (%)
	by state	on the face	
BM-13	144	151	105

Table 58

Armament of formations and units of artillery of the RVGK on January 1, 1945

Weapon name	Number of weapons		Staffing (%)
	by state	on the face	
BM-8	312	352	113
BM-13	2144	2032	95

BM-31-12	768	771	101
Frames M-31	2916	3614	124
Total	6140	6769	110

Table 59

The composition of the rocket artillery of the RVGK, army and corps on January 1, 1945

Name of connection and parts	Number of connections and parts											
	artillery RVGK			army artillery			corps artillery			Total		
	divisions	dep. brigades	shelves	divisions	dep. brigades	shelves	divisions	dep. brigades	shelves	divisions	dep. brigades	shelves
Total:	7	15	101	3	-	6	-	7	37	15	114	40
Including:												
jet	-	-	101	3	-	6	-	7	37	-	114	40
heavy jet M-31	-	ten	-	-	-	-	-	-	-	ten	-	-
heavy jet M-31-12	-	five	-	-	-	-	-	-	-	five	-	-

In some M-13 regiments armed with BM-8 combat mounts, the latter were replaced by standard BM-13 combat mounts. The role of rocket artillery during the capture of Berlin is especially worth noting. So, when crossing the Teltow Canal by the 3rd Guards Tank Army, 1110 guns and mortars of all calibers, 146 self-propelled artillery mounts and 215 combat mounts of BM-13 and BM-31-12 field rocket artillery were concentrated on the 4.5 km wide offensive sector. The offensive began at 7.30 a.m. on April 24, and it was only by 10 a.m. on April 25 that the 3rd Guards Tank Army finally crossed the channel.

In street battles, it often happened that houses on one side of the street were occupied by the enemy, and on the opposite - by our units. In order to knock the enemy out of the houses he occupied, it was necessary either to reliably suppress him, or to destroy the houses in which the Germans settled. In such cases, heavy field rocket artillery shells (M-31) were used very effectively. They were raised to the second and third floors of buildings occupied by our units, and, thanks to the simplicity of firing a shot (the capping itself served as a guiding frame), they sent shells directly from the windowsills into the windows of houses on the opposite side of the street, in which the Germans were. Bursting inside buildings, the shells caused great destruction and fires. (Fig. 118)

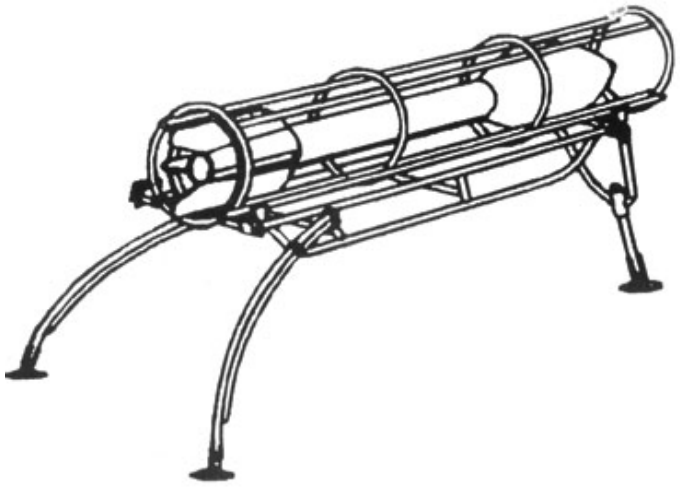


Fig. 118. Portable launcher M-30

During the battles for Berlin, middle commanders created impromptu assault groups equipped with rockets. They were called that: PC assault teams. They received one or two guides, 3-4 M-13 or M-20 projectiles, sometimes M-31 in a cork. They were shooting with direct fire from the windowsills of buildings, or even directly from the ground.
During the Berlin operation, the Soviet rocket artillery used up 372,230 shells of 82, 132 and 300 mm caliber.

Table 60

Armament of formations and units of corps artillery on May 1, 1945

Weapon name	Rifle corps		Cavalry corps		Tank and fur. corps		Total		Staffing (%)
	by state	on the face	by state	on the face	by state	on the face	by state	on the face	
BM-8	-	-	84	88	-	3	84	91	108
BM-13	72	70	-	12	296	286	368	368	one hundred
Total	72	70	84	one hundred	296	186	452	459	102

Table 61

Armament of formations and units of artillery RVGK on May 1, 1945

Weapon name	Number of weapons		Staffing (%)
	by state	on the face	
BM-8	312	265	85
BM-13	2024	1968	97
BM-31-12	1008	1047	104
Frames M-31	2196	2771	126
Total	5540	6051	109

Table 62

Armament of army artillery on May 1, 1945

Weapon name	Tank armies		Staffing (%)
	by state	on the face	
BM-8	-	8	
BM-13	192	191	
Total	192	199	104

Table 63

The general composition of the artillery artillery of the ground forces on May 1, 1945

Weapon name	By state				On the face				Staffing (%)
	corps artillery	army artillery	artillery RVGK	Total	corps artillery	army artillery	artillery RVGK	Total	

BM-8	84	-	312	396	91	8	265	364	92
BM-13	368	192	2024	2584	368	191	1968	2527	98
BM-31-12	-	-	1008	1008	-	-	1047	1047	104
Frames M-31	-	-	2196	2196	-	-	2771	2771	126
Total	452	192	5540	6184	459	199	6051	6709	108

Chapter 11

"Katyushas" shoot at ... planes. Use of M-8 and M-13 shells in anti-aircraft installations

The first experiments in firing missiles at airships were made at the beginning of the 20th century in France. For this, incendiary rockets were used. In Russia, in 1909, M. M. Pomortsev proposed "to install launching devices on cars to combat aeronautical targets."
Practical launches of experimental anti-aircraft missiles, created on the basis of illuminating rockets, were carried out in the same 1909 near Sestroretsk.
In the USSR, work on anti-aircraft missiles was first started in 1940 at NII-3. An anti-aircraft launcher with 12 guides for firing M-13 rockets was designed there. It was mounted on a single axle trailer. In the firing position, the launcher was installed on four folding jacks. Missile tests were unsuccessful, and work on them was stopped.
In November 1941, the commander of a platoon of anti-aircraft machine guns of the 64th airfield service battalion, junior lieutenant N.I.Baranov, designed anti-aircraft installations for firing RS-82 and PC-132 aircraft missiles. Guides and other elements of aircraft launchers were used in these installations. At the direction of General I.P. Zhuravlev, the field aircraft factory produced four 24-charge units for 82-mm RS-82 rockets and two 12-charge units for 132-mm PC-132 rockets. The rocket launchers were tested by experimental firing and tables for anti-aircraft and ground firing were compiled for them. The division, consisting of six rocket launchers, provided cover for airfields near Tikhvin and on Lake Ladoga.
The units were mounted on the ZIS-5 vehicle chassis. The maximum elevation angle of the units is 85 °. The shells were equipped with spacer tubes.
Based on the samples of NI Baranov's anti-aircraft missile systems at the airfields of the Leningrad and Volkhov fronts, individual inventors and innovators produced 2-, 4-, 6-, 8- and 12-charge anti-aircraft missiles for launching M-8 rockets on their own initiative.
For the first time in combat conditions, two anti-aircraft launchers, created by NI Baranov, were used on November 14, 1941; the operator of one of the launchers was the inventor himself. Near the village of Sorozha, not far from Tikhvin, the German Junkers-88 bomber was shot down by anti-aircraft missiles while protecting the headquarters of the Northern Group of the 4th Army from an air attack. Standard aircraft M-8 missiles were used as shells.
Several types of improvised anti-aircraft launchers for M-8 and M-13 missiles were created in the Black Sea Fleet in 1942-1943. The first case of firing missiles from a ship at planes occurred on April 2, 1942. In this regard, in 1944, the Military Publishing House even published tables of firing an M-13 projectile with a TC-13 ballistic index for aircraft. The shells were equipped with a 6-second remote tube. It was recommended to create fixed curtains for aircraft with an inclined range of 2400 m.
In addition to army and naval craftsmen, the design team of the SKB of the Compressor plant, specialized in the creation of launchers, was also involved in the design of anti-aircraft launchers during the war years.
In 1943, on the instructions of the Main Armament Directorate of the Guards Mortar Units, SKB developed 40-charge anti-aircraft launchers on the chassis of the GAZ-AA car and on a single-axle trailer for 82-mm M-8 rockets. Samples of installations were tested for strength, safety, reliability of action by shooting and running. The tests passed with positive results. But further tests of the system revealed the insufficient combat effectiveness of the M-8 missile. Anti-aircraft guns were not accepted for service, and work in this area at the SKB was stopped.

Chapter 12

Descendants of the Typhoon

In 1942-1945 in Germany, along with work on guided anti-aircraft missiles (Wasserfall, Schmetterling, Entsian, etc.), the Typhoon unguided anti-aircraft missile was created. In terms of its weight and size characteristics, it was close to the

Soviet "Katyusha" (M-13). The rocket length was 1970-2000 mm, the body diameter (caliber) was 100 mm, the stabilizer span was 220 mm.

The Typhoon missile was manufactured in two versions: Typhoon R and Typhoon F. The main difference between the P and F variants was in the engine. Option P had a solid propellant (powder) engine, which developed a thrust of 2100 kg for 1.5-1.7 seconds. The rocket developed a maximum speed of about 1150 m / s. The ceiling of the rocket is about 13 km, while the horizontal range was about 12 km. (Fig. 119)

The rocket was stabilized by a four-winged stabilizer. The wings were oblique (about 1 °). Due to this, the rocket had a slight rotation, up to 150 rpm. The dispersion at high firing altitudes was 1/140 of the slant firing range.

The warhead of the rocket contained 0.7 kg of explosive explosive impact.

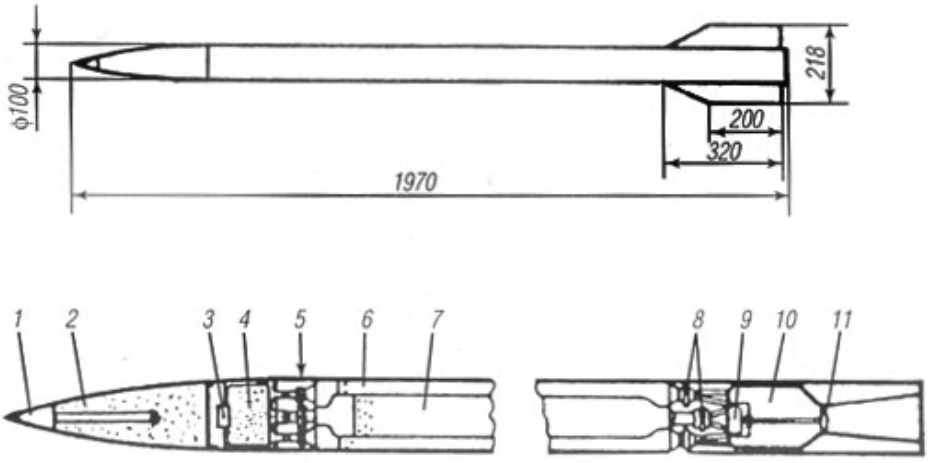


Fig. 119. German liquid-propellant unguided anti-aircraft missile Typhoon F
1 - shock fuse;
2 - explosive charge;
3 - gas generator electric igniter;
4 - cordite gas generator;
5 - bursting discs;
6 - visol fuel tank (vinyl esters);
7 - salbay oxidizer tank (98-100% HNO_3);
8 - bursting discs;
9 - plug to delay the supply of the oxidizer;
10 - combustion chamber;
11 - piston in the throat of the nozzle.

The dimensions and appearance of the Typhoon F missile hardly differed from the Typhoon R variant. The warheads of both missiles were the same. The Typhoon F liquid-propellant jet engine developed a thrust of 615 kg for 2.5 seconds. A mixture of butyl ether with ammonia was used as fuel, and nitric acid was used as an oxidizing agent. The Typhoon F missile had a higher ceiling than the Typhoon R, 15.4 km.

The Typhoon-F and Typhoon R missiles were supposed to be fired from towed launchers on a cart from an 88-mm anti-aircraft gun. Both versions of the Typhoon were brought to the stage of mass production. However, the defeat of Germany by the Soviet Army prevented the Germans from starting the massive use of Typhoon missiles. Although there were isolated cases of combat use.

Both versions of the Typhoon fell into the hands of the Soviet command. On April 14, 1948, the Council of Ministers issued a decree No. 1175-440 on the deployment of work on the creation of unguided anti-aircraft missiles.

The leadership of the USSR instructed NII-88 to modify the Typhoon F rocket (with a liquid engine), for which a special department No. 6 was created there, headed by chief designer Pavel Ivanovich Kostin. The Soviet version of the Typhoon F was named the R-110 Teal. The ceiling of this rocket was at least 18 km.

During the tests of the "Chirka" at the Kapustin Yar range, there were problems with the accuracy of fire. As V. V. Kazansky * wrote: “... the Germans (and we too) wanted to compensate for the low accuracy of a large number of missiles fired at aircraft, nevertheless, it was indicated in the TTZ and the military insisted on achieving it ... accuracy in the air was not possible, the ballistics of P.I. Kostin's design bureau, with the consent of the military, transferred the given deviations to the horizontal plane, while missing out on the fact that the dispersion of shells at the target in the air and during their further uncontrolled flight to the ground would naturally differ. But this omission entered the official documents, after

which a long and unsuccessful struggle began for its required accuracy in a square on the ground, which naturally did not lead to success. The chief designer's attempts to prove to the customer (the Ministry of Defense) using ballistic calculations the illegality of the decision taken were very long. To this was added periodic burnouts of the combustion chambers of the missiles (approximately for every 14-15th rocket), and all the usual mechanical methods (replacing steel grades, changing the diameter of the holes in the nozzles) did not lead to success. And only when this type of rocket was transferred to OKB-3 of Dominik Dominikovich Sevruk, where real liquid engines were assembled, this issue was immediately resolved by adding oxidizer streams to the wall of the combustion chamber. However, by this time (it was already 1953) the customer had lost interest in this type of anti-aircraft weapons, since the altitude of the aircraft began to significantly exceed the reach of the Chirk. " To this was added periodic burnouts of the combustion chambers of the missiles (approximately for every 14-15 rocket), and all the usual mechanical methods (replacing steel grades, changing the diameter of the holes in the nozzles) did not lead to success. And only when this type of rocket was transferred to OKB-3 of Dominik Dominikovich Sevruk, where real liquid engines were assembled, this issue was immediately resolved by adding oxidizer streams to the wall of the combustion chamber. However, by this time (it was already 1953) the customer had lost interest in this type of anti-aircraft weapons, since the altitude of the aircraft began to significantly exceed the reach of the Chirk. " To this was added periodic burnouts of the combustion chambers of the missiles (approximately for every 14-15 rocket), and all the usual mechanical methods (replacing steel grades, changing the diameter of the holes in the nozzles) did not lead to success. And only when this type of rocket was transferred to OKB-3 of Dominik Dominikovich Sevruk, where real liquid engines were assembled, this issue was immediately resolved by adding oxidizer streams to the wall of the combustion chamber. However, by this time (it was already 1953) the customer had lost interest in this type of anti-aircraft weapons, since the altitude of the aircraft began to significantly exceed the reach of the Chirk. " And only when this type of rocket was transferred to OKB-3 of Dominik Dominikovich Sevruk, where real liquid engines were assembled, this issue was immediately resolved by adding oxidizer streams to the wall of the combustion chamber. However, by this time (it was already 1953) the customer had lost interest in this type of anti-aircraft weapons, since the altitude of the aircraft began to significantly exceed the reach of the Chirk. " And only when this type of rocket was transferred to OKB-3 of Dominik Dominikovich Sevruk, where real liquid engines were assembled, this issue was immediately resolved by adding oxidizer streams to the wall of the combustion chamber. However, by this time (it was already 1953) the customer had lost interest in this type of anti-aircraft weapons, since the altitude of the aircraft began to significantly exceed the reach of the Chirk. "

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* "Roads to Space". Memoirs of veterans of rocket and space technology; From ki and cosmonautics ". M., Publishing house MAI, 1992.S. 99-100.

Alas, here Kazansky's memory clearly refused. First, in 1953, the operating ceiling of both bombers and fighters did not exceed 10 km (remember the Korean War), and the operating altitude of promising fighters and bombers did not exceed 18 km. And secondly, in the USSR, work on unguided anti-aircraft missiles in 1953 did not stop. Thus, work continued on the RZS-115 anti-aircraft system, which included the Strizh unguided powder rockets (analogue of the Typhoon R). Launchers for the RZS-115 system were designed at GSNII-642 and manufactured by plant # 232 Bolshevik. In accordance with the tactical and technical requirements, the independently operating firing unit (battery) of the RZS-115 was supposed to provide the release of about 1,500 shells in 5-7 seconds. To ensure this, the battery complex was required to include 12 launchers for 120 barrels each with charging equipment (a total salvo of 1440 shells), etc.

Projectile data "Swift"	
Projectile caliber, mm	115.2
Plumage span, clb	2,257
Projectile length, m	2.94
Projectile weight, kg	53.65
Explosive weight, kg	1.6
Explosive	TNT
Powder charge weight, kg	18.75
Length of the active section of the trajectory at an angle of 48 °, m:	
at a temperature of - 40 ° C	1188
+ 15 ° C	938
+ 40 ° C	850
Projectile speed at the end of the active section of the trajectory at an angle of 48 °, m:	
at a temperature of - 40 ° C	718
+ 15 ° C	767
+ 40 ° C	783
Projectile engine operating time, s:	
at a temperature of - 40 ° C	3.11
+ 15 ° C	2.24

+ 40 ° C	1.81
Maximum horizontal range, km	22.7
Maximum projectile reach (at an angle of 88 °), km	16.5
Combat reach at horizontal range	
5000 m and speed of meeting with the target 195 m / s, km	13.9
Projectile flight time at altitude	37.4
Average accuracy of salvo fire	
to the zenith (from slant range)	1/144
Time of elimination of the projectile warhead, s	44.6-46.2
Remote tube operating time	
in the temperature range ± 40 ° C, s	36.1-40.2

The launcher was towed. A package of 120 tubular guides was mounted on it. Rail length 3145 mm. The vertical guidance angle is from + 30 ° to + 88 °, the horizontal guidance angle is 360 °. The maximum speed of vertical guidance is 9 deg / s, horizontal guidance is 20 deg / s.

In the stowed position, the launcher was transported unloaded. Its weight was 12 tons. The AT-S tracked tractor or the YaAZ-214 vehicle could be used as a tractor. The towing speed was determined by the capabilities of the tractor.

Installation dimensions in the stowed position: length (with boom) 9.1 m, width 3 m, height 3.37 m, ground clearance 390 mm.

When the launcher was transferred from the traveling position to the combat moves, they were separated. The transition time from traveling to combat or vice versa was about 60 minutes. After that, the installation was charged, the charging time was 3-4 minutes. The weight of the loaded launcher (without moves) was 20.5 tons. The launch time of all 120 shells from the launcher was adjusted from 6 to 30 seconds.

The battery included a trailer with a computing-decisive equipment (CCD), which worked according to the data of the SON-30 radar station. The limits of work of the CCD in terms of target range from 0 to 50 km, target speed up to 600 m / s. The weight of the trailer with PUS is 5.6 tons.

As the tests showed, the SON-30 radar confidently accompanied the Strizh projectile automatically along all coordinates with root mean square errors: along the slant range - 17 m; along the normal to the slant range in the firing plane - 24 m; along the normal to the firing plane - 21m.

Work on the RZS-115 from the very beginning went behind schedule due to difficulties with the powder engine and the overloading of executors with other orders. In February 1954, factory tests of the Strizh launcher and projectile were successfully completed. According to the results of factory tests, the launchers and shells were finalized, and in November 1955, two launchers and 2500 shells were presented for field tests.

In March 1956, military unit 15 644 completed field tests of two launchers and Strizh projectiles with positive results. During these tests, ballistic tables were shot, which were put into a calculating device developed by NII-20 MOP.

Comprehensive field tests of the RZS-115 as part of the SON-30 radar station, a computing device, a battery command post and three launchers (instead of 12 standard) were carried out at NIAP in the period from December 1956 to June 1957.

Based on the results of complex tests of the RZS-115, the country's air defense leadership made the following conclusions: “Due to the small reach of Strizh projectiles but the height and range (height 13.8 km with a range of 5 km), the limited capabilities of the system when firing at low-flying targets (less than angle of 30 °), as well as insufficient gain in the effectiveness of the complex's firing compared to one or three batteries of 130-mm and 100-mm anti-aircraft guns with a significantly higher consumption of projectiles, the RZS-115 reactive anti-aircraft system cannot qualitatively improve the armament of anti-aircraft artillery air defense forces country.

It is inexpedient to adopt the RZS-115 system into the armament of the Soviet Army to equip parts of the country's anti-aircraft artillery troops.

Here it is worth noting a rather curious nuance - in none of the documents of the case on the development and testing of the Strizh missile there is not a single comparison with the S-25 and S-75 anti-aircraft guided missiles (SAMs), which by 1957 were already in serial production ... Either the guided missiles were so classified, or it was planned to use the Swifts in parallel with anti-aircraft guided missiles to perform various tasks. For example, SAMs were supposed to hit single aircraft, and Swifts were supposed to hit large clusters of strategic bombers.

According to the author, unguided anti-aircraft missiles had a right to exist in the first post-war decade. Unfortunately, the development of the Strizh-type missiles took a long time. And these missiles could play a significant role in Korea, where American B-29 bombers operated in close formation. Moreover, unguided rockets would be very effective when firing at closely flying large groups of "flying fortresses". Moreover, they would force the formation of bombers to crumble, after which they would become easy prey for MiG-15 aircraft.

Further